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NOISE PROGRAMS OF PROFESSIONAL/INDUSTRIAL ORGANIZATIONS, UNIVERSITIES AND COLLEGES

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Prepared by

for the

U.S. Environmental Protection Agency
Office of Noise Abatement and Control
Washington, D.C. 20460

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INTRODUCTION

The Noise Pollution and Abatement Act of 1970, Title IV, Section 402 of Public Law 91-604 directed EPA to undertake a full and complete investigation and study of noise and its effect on the public health and welfare and to report thereon to the President and the Congress. This technical report has been prepared by the Office of Noise Abatement and Control of the Environmental Protection Agency as a supporting document to the required report.

This document provides information pertaining to noise programs being sponsored or carried out, either directly or indirectly, by professional, industrial, and voluntary associations (societies) and provides information on private industry research and educational and research programs. Also provided is a bibliography of pertinent publications relating to noise. The information contained in this report is based upon that requested and received from the Scientific Information Exchange of the Smithsonian Institute and the Acoustical Society of America and that obtained by the Office of Noise Abatement and Control from professional organizations.

Section 1 of this report discusses the noise programs of industrial, professional, and voluntary associations (societies) and the research activities conducted by these organizations and private industry. Appendix A shows the many professional and industrial organizations, and Appendix B showing the standards currently recommended by the American National Standards Institute relative to acoustics and noise, is also provided as an example of the extensive voluntary standard effort regarding this problem (N. B. Similar "standard" activity is in existence in the Society of Automotive Engineers, the Acoustical Society of America, and other organizations).

Section 2 describes the current status of academic training and research programs in noise control at the graduate level. Appropriate Appendixes C and D are provided to show in some detail the program activities of the colleges and universities.

Section 3 provides a brief description of the types of publications available on noise and related areas for the general and professional audiences. Appendixes E and F provide bibliographies of periodical publications and books relevant to noise and its control.

SUMMARY

The contributions and impact of the media described in this report has been significant. Professional/industrial associations have contributed significantly to proposed testing procedures and the development of criteria and standards for noise control. Universities and colleges are increasing their training emphasis in noise oriented programs and contribute significantly with basic and applied research programs in several areas of noise and acoustics. No less significant has been the contribution of various scientific and nontechnical publications to the public understanding of noise.

SECTION 1

INDUSTRIAL, PROFESSIONAL, AND VOLUNTARY ASSOCIATIONS

The importance of the effects of noise and its abatement and control is reflected by the concerted efforts of many industrial, professional, and voluntary associations throughout the country. Their activities in research and development programs for the control of noise, hearing conservation for the protection and well-being of personnel, and especially the voluntary initiative of several professional and industrial organizations in establishing criteria and standards reflects not only a national awareness of a significant problem but a willingness and ability to resolve it. The efforts of these organizations, because they were generated within their membership, shows the absence of governmental influences. Further, their efforts have not been a reflexive or reactionary response to overtures and public dissatisfactions to noise problems that have projected in recent years. Instead, the efforts of many of the organizations reflect active engagement during the past 15 to 20 years.

NONRESEARCH ACTIVITIES

Interest in noise and noise related problems is demonstrated by over 100 professional/ industrial organizations. Appendix A provides a listing of these groups. Some of these organizations have a direct interest, while the interest of others may be tangential. The Acoustical Society of American (ASA) is, perhaps, one of the larger professional societies directly engaged in a broad spectrum of noise and acoustic problems. ASA is currently developing a program for its Coordinating Committee on Environmental Acoustics, which will establish means for defining environmental problems, in societal

and technical terms, and for disseminating information for the evaluation and solution of the problems to the problem-solving community. The Society of Automotive Engineers (SAE) and the American Society of Mechanical Engineers (ASME) have directed efforts over the years to preparing suggested standards for the safety and protection of the public. The Department of Labor has adopted for its use certain of the proposed standards recommended by ASME. SAE publishes material in the form of information reports and recommended practices, which are developed by such SAE committees as the Vehicle Sound Level Committee and Aircraft Noise Measurement and Aerospace Equipment Division Committee. Examples of published documents by these committees include, Exterior Sound Level for Snowmobiles, Exterior Loudness Evaluation of Heavy Trucks and Buses, Sound Levels for Engine Powered Equipment, Methods of Comparing Aircraft Takeoff and Approach Noises, Jet Noise Prediction, and Measurements of Aircraft Exterior Noise in the Field. There are approximately 20 documents published by SAE for the benefit of others working in the areas of noise and acoustics.

Since 1947, hearing conservation has received the primary emphasis from the Subcommittee on Noise in Industry of the American Academy of Ophthalmology and Otolaryngology. This group has prepared and distributed guides and manuals and has participated in symposia concerned with industrial hearing loss. Industrial hygiene organizations are involved to a substantial degree in noise related problems. The American Conference of Governmental Industrial Hygienists actively concerns itself with noise in the industrial environment through the Physical Agents Committee, which is composed of 9 to 12 members. The work of this committee contributed to the development of the standards in the Walsh-Healey Act. The American Industrial Hygiene Association directs concerted efforts toward the problem of industrial hearing loss through an interindustry noise subcommittee. Presently, this committee is revising the Industrial Noise Manual published by the parent association.

The American National Standards Institute (ANSI) is the national organization that represents industry, the consumer, and the government to meet demands for voluntary national standards. Through its committees on acoustics, bioacoustics, and shock and vibration, ANSI coordinates the work of standards development in the private sector in the area of noise. ANSI has published approximately 40 standards in acoustics and vibration related to noise problems. In addition to developing new standards, these committees, which have between 30 and 40 members, continue to review and revise existing standards as required. Appendix B provides relevant standards recommended by ANSI.

Testing procedures, certification, and rating of various noise producing products are included in the efforts of professional and industrial organizations. For example, the Engine Manufacturers Association has been developing, through its noise standards committee, test procedures for use in noise measurement and abatement of noise emissions from engines. Similarly, the Air Conditioning and Refrigeration Institute has developed a sound certification program and sound rating procedures for outdoor air conditioning units. Another organization, the American Society for Testing and Materials, has proposed a standard method for testing sound absorption and acoustical materials in reverberation rooms. Test procedures for tractors, in which noise measurement information at the operator's ear is obtained, have been recommended by an agricultural tractor test code approved by the American Society of Agricultural Engineers and SAE.

RESEARCH ACTIVITIES

Private industries and institutes, professional organizations, and citizens groups are continually and actively engaged in research activities. Their noise research activity as in the case of the universities, is supported largely by Federal agencies. Some of the noise problems being investigated by these

groups include: construction operations, building equipment and home appliances; transportation noise, high intensity noise environments, establishment of international standards, industrial plant noise, and effects of noise on the quality of human life. Table 1-1 shows the various research efforts being conducted by these organizations. Considerable effort is directed toward aircraft and ground transportation noise problems.

VOLUNTARY ANTINOISE ORGANIZATIONS

The environmental impact of noise is exemplified by the concerted efforts and interest generated by voluntary antinoise organizations. Such organizations as Citizens Against Noise exert their influence on various levels of government to control and abate noise in our communities. A list of some of these groups is provided at the end of Appendix A.

SUMMARY OF INDUSTRIAL, PROFESSIONAL AND VOLUNTARY EFFORTS

A significant impact and contribution is being made toward the control and abatement of noise by the various professional and industrial organizations. These groups, in many instances, develop through their various committes proposed methods of testing and evaluating noise problems and, in addition, have developed criteria and standards for the control of environmental noise. Their efforts are a major source of the present awareness and understanding of the overall noise problem. Research by private industry is continually contributing to the basic understanding and applied technology of noise abatement and control.

TABLE 1–1

SUMMARY OF RESEARCH ACTIVITY IN NON–ACADEMIC INSTITUTIONS

Organization	Supporting Source		Funding Level		Activity
	Federal	Private	$(K)	(FY)	
American Institute of Physics	NSF		21.4	(70)	establish international standards of noise, noise abatement
ARA, Inc.	DOD (AF)			(71)	effect of camber on sonic booms
Battelle Memorial Institute	DOD (AF)			(71)	environmental effects on people from aviation noise
Bolt, Beranek and Newman	EPA		105	(72)	construction operations & equipment, building equipment & house appliances
Bolt, Beranek & Newman, Inc.	DOT			(70)	highway noise standards
Bolt, Beranek & Newman, Inc.	DOT		31	(70)	metro, aircraft noise abatement
Bolt, Beranek & Newman, Inc.	DOT		16.8	(70)	mass transportation acoustical environment
California State Assembly	DOT		331	(70)	noise abatement and steam bus
California State Division of Highways	DOT		49.5	(71)	traffic noise effects on design & environmental variables
Caterpillar Co.	DOD (A)		205	(71)	noise emission reduction
Central Institute for the Deaf	EPA		23	(72)	effects of noise on the quality of human life
Central Institute for the Deaf	HEW			(71)	hearing loss & noise exposure
Citizens for a Quieter City (N.Y.)		Ford Foundation	300	(71)	reduction of noise levels from industrial equipment

*This information is based upon that provided by the Scientific Information Exchange, Smithsonian Institution, Washington, D.C. (9/27/71). This cannot be considered an all inclusive listing of noise research.

†Funding level is reported if known. If not reported, either the funding level has not been provided or the noise research was part of a project or program from which the funding of the activity could not be extracted.

TABLE 1–1 (Cont.)

Organization	Supporting Source		Funding $(K)	Level (FY)	Activity
	Federal	Private			
Cornell Aeronautical Lab., Inc.	DOD (AF)			(70)	turbofan engine noise generation
Curtis Wright Corp.	DOD (N)			(71)	noise reduction of observation aircraft
Goodfriend Ostergard Associates	EPA		63	(72)	industrial plant noise (external)
Howard Co. Bd. Educ., Maryland		Educ. Facil. Labs., Inc.	5	(70)	sound control in open schools
Industrial Acoustics Corp.	DOD (AF)		2,630	(70)	demountable & portable sound suppression equipment
Industrial Acoustics Corp.	DOD (AF)			(71)	sound suppression equipment
Industrial Acoustics Corp.	DOD (AF)			(71)	portable exhaust muffler
Informatics, Inc.	EPA		51.8	(72)	survey of foreign noise abatement and control efforts
Koppers Co.	DOD (AF)		3,121	(69)	demountable suppressor systems
Koppers Co.	DOD (AF)		87	(70)	demountable suppressor systems
Michigan State Div. Highways	DOT		81.4	(71)	·.·an noise pollution
Rochester Applied Science Assoc.	DOD (A)			(71)	·..licting helicopter noise
San Francisco Bay Ar. Trans. Dist.	DOT			(70)	no. reduction
Serendipity, Inc.	DOT		492.7	(70)	transportation noise generation & abatement
Society of Automotive Engrs., Inc.	DOT		5	(69)	transportation noise levels & abatement
Stanford Research Institute				(71)	noise monitoring instrumentation (no formal support)
Stanford Research Institute	HEW		76.3	(71)	physiological and psychological adjustment to noise
Stanford Research Institute	HEW		125.3	(71)	noise induced hearing loss
Stanford Research Institute	DOD (AF)			(71)	high intensity noise environments

TABLE 1–1 (Cont.)

Organization	Supporting Source		Funding $(K)	Level (FY)	Activity
	Federal	Private			
United Aircraft Corp.	DOD (A)			(71)	helicopter noise
Wyle Laboratories	DOD (A)		30	(70)	sound absorption in the atmosphere
Wyle Laboratories	DOD (AF)			(70)	internal noise levels & structural response of noise from VSTOL aircraft
Wyle Laboratories	DOD (A)			(71)	helicopter aerial detectability criteria
Wyle Laboratories	EPA		139.4	(72)	community noise, transportation and other internal-combustion produced equipment

TOTAL 7,990.6

SECTION 2

EDUCATIONAL PROGRAMS

TRAINING ACTIVITY

A survey of graduate education in acoustics was recently completed by the Acoustical Society of America (ASA). In over 90 institutions of higher learning, courses are being offered in different areas of acoustics, including noise and noise control. Course offerings related to noise and noise control are primarily offered through the departments of mechanical engineering, and such courses are offered in 38 of the universities. Appendix C presents those universities and colleges offering graduate work in acoustics. Even though graduate training in noise control is increasing, there continues to be a need for increased attention to the legal aspects of noise and land transportation. Only two schools offer noise control courses relative to legal aspects, and only four institutions offer noise control courses relative to land transportation. The current academic emphasis in noise control is directed toward aerodynamics, vibration induced noise, structural response, and machinery. Appendix D presents a description of some courses in acoustics and noise offered by institutions.

The majority of institutions currently offering noise-oriented programs plan to increase their faculty, and nearly all plan to add sequential courses to increase the depth of training. Only a little over one-half of the programs anticipate requiring courses in other departments to accomplish this.

RESEARCH ACTIVITIES

Research programs related to noise are being conducted outside of the federal government principally by departments, institutes, or divisions of

large universities. On the basis of data in Table 2-1, over 90 percent of the research being conducted by 34 universities is supported by various federal agencies. The research projects/programs conducted by these institutions cover a broad spectrum of activity. Studies related to hearing loss and noise exposure are being conducted at several universities, as are studies on the effects and control of noise in rural areas. The latter area includes work on dissipation rates of certain noises in recreational environments, noise control in rural housing, noise generation of agricultural equipment, and effects of vegetative growth on noise abatement. Other universities are researching timely studies on transportation noise (aircraft and ground), while others are investigating sound transmission and attenuation in buildings, effects of noise on wildlife and domestic animals, physiological and psychological effects of noise on humans, and attenuation of industrial machinery noises. Table 2-1 shows the research activity being conducted by academic institutions and the source of funding.

Table 2–1

Summary of Research Activity in Academic Institutions*+

Organization	Supporting Source			Industry	Funding Level* K$ (FY)	Activity
	Federal	State	Private			
UNIVERSITIES:						
Cornell University			Resources for the Future, Inc.		58.4 (70)	control of urban noise
Cornell University	DOD (AF)				(70)	aerodynamic-noise generation
Duke University		North Carolina			(71)	attenuation of noise generated by industrial machines
George Washington University Law School	EPA				43.7 (72)	legal survey
Georgia Institute of Technology	NASA				5.6 (7[illegible]	helicopter blade slap noise
Harvard University	DOD (AF)				(70)	physiological performance from environmental stress, including noise
Iowa State University	USDA				(70)	noise isolation in garden apartments
Iowa State University	USDA				(70)	noise control and effects on woods in garden apartments
Mass. Institute of Technology	DOD (A)				(71)	helicopter noise generation reduction
Mass. Institute of Technology	NSF				73 (71)	sound transmission in buildings
Memphis State University	EPA				23.3 (72)	effects of noise on animals (wildlife & domestic)
Miami University	DOD (AF)				(71)	high intensity noise effects on equilibrium
New York University			Russell Sage Foundation		30.9 (70)	noise stress effects on individual and social behavior

*This information is based upon that provided by the Scientific Information Exhange, Smithsonian Institution, Washington, D.C. (9/27/71). This cannot be considered an all inclusive listing of noise research.

+Funding level is reported if known. If not reported, either the funding level has not been provided or the noise research was part of a project or program from which the funding of the activity could not validly be extracted.

Table 2–1 (Cont.)

Organization	Supporting Source			Funding Level*		Activity
	Federal	State	Private	Industry	K$	(FY)	
UNIVERSITIES (Cont.):							
Rhode Island School of Design			Intl. Lead Zinc Res. Organization			(70)	sound attenuation in building construction
Stanford University School of Medicine	DOD (A)					(71)	behavioral effects of stress producing influences, including noise
State University of New York & USDA Forest Service	USDA					(70)	dissipation rates of selected noises in recreational environments
Texas A & M	USDA					(70)	noise control in rural housing
University of Alabama Res. Institute	NASA					(70)	airport noise
University of Alaska	USDA					(71)	sonic boom effect on behavior, growth & reproduction of farm mink
University of California	DOT				125.5	(70)	impacts & alleviation of transportation noise
University of Dayton	DOD (AF)					(70)	identify and define noise environments
University of Georgia	USDA					(70)	noise attenuation in rural dwellings
University of Georgia	HEW				10.7	(70)	behavioral toxicity of noise
University of Houston	NSF				26.9	(70)	sound generation & reduction
University of Illinois				Sundstrand	15	(70)	hydraulic systems
University of Illinois Ag. Exp. Station	USDA					(71)	noise generation & levels of agricultural & industrial equipment & operator environments
University of Maryland	NSF				44.7	(71)	noise pollution monitoring program related to meteorological conditions
University of Minnesota	HEW				29.6	(71)	hearing loss susceptibility and noise exposure

Table 2–1 (Cont.)

Organization	Federal	Supporting Source: State	Supporting Source: Private	Industry	Funding Level* K$	(FY)	Activity
UNIVERSITIES (Cont.):							
University of Missouri	NSF				13	(71)	intense sound control of acoustic filters
University of Nebraska	DOT				62	(70)	plant materials & noise abatement
University of Nebraska	USDA					(71)	noise abatement control of tractors
University of Nebraska	USDA					(71)	trees & shrubs for noise abatement
University of Oregon Medical School	HEW					(71)	hearing loss and noise exposure
University of Pittsburgh	HEW					(71)	stress related to noxious audiogenic stimuli
University of Rochester	DOD (AF)					(70)	high intensity sound
University of South Dakota	DOD (AF)					(71)	noise limits & performance impairment
University of Southern California	NSF					(71)	air traffic noise
University of Vermont	HEW				39.3	(71)	biological effects of high intensity sound
University of Virginia	NSF				15	(70)	nearfield structure of sonic booms
University of Washington	DOT				24.4	(70)	evaluating transportation noise
University of Washington	USDA					(71)	sonic boom effect on behavior, growth & reproduction of farm mink
Washington University	NASA				8.4	(70)	axisymmetric nonlinear wave propagation
				TOTAL	649.4		

SECTION 3

PUBLICATIONS

Such publications relating to noise exist in the form of newsletters, scientific journals, text books, technical reports, and manuals. Recent books include those of a highly technical nature, such as Effects of Noise on Man, by Karl D. Kryter and Noise and Vibration Control by Leo Beranek, as well as those aimed at the nontechnical community including The Fight for Quiet by Theodore Berland and The Tyranny of Noise by Alex Baron. Books devoted to specific subjects such as Transportation Noises, by J. D. Chalupnik (Ed), and Noise Pollution and the Law by James L. Hillebrand are available for those with interest in and need for specialized information. Significant contributions have been made by Federal agencies through their publications, which include The Noise Around Us by the Department of Commerce and Noise: Sound Without Value by the U.S. Federal Council for Science and Technology. Appendix E provides a bibliography of relevant books published during the past 20 years.

There are over 40 periodicals regularly featuring articles that relate specifically to acoustics and noise, and there are over 50 publications that frequently publish articles related to noise problems, and over 50 publications that frequently contain articles related to noise problems. The Journal of the Acoustical Society of America publishes monthly scientific research reports specific to noise and noise related problems. Noise is one of several subjects dealt with in the Journal rating a separate associate editor. The Archives of Otolaryngology of the American Medical Association and the Journal of Speech and Hearing Research of the American Speech and Hearing

Association publish articles on noise as it relates to human communication. The quarterly Noise Measurement is produced by General Radio Corporation, a major electronics manufacturer. A wide spectrum of acoustic (noise) and vibration subjects are published monthly for the professional community in the controlled circulation publication Sound and Vibration. Appendix F provides a bibliography of periodicals that, to varying degrees, treat noise, acoustics, and related problems.

Appendix A

PROFESSIONAL, INDUSTRIAL AND VOLUNTARY ORGANIZATIONS WITH INTERESTS AND ACTIVITY RELEVANT TO NOISE AND ACOUSTICS

I. ASSOCIATIONS (AUDITORY) WITH SUBSTANTIAL INTERESTS AND/OR ACTIVITIES RELATED TO NOISE PROBLEMS

Acoustical and Insulating Materials Association

Acoustical Society of America

Acoustical Society of Japan

Alexander Graham Bell Association for the Deaf

American Academy of Opthalmology and Otolaryngology

American Association of Opthalmology

American Speech and Hearing Association

Audio Engineering Society

British Acoustical Society

British Society of Audiology

Ceilings and Interior Systems Contractors Association (Ill.)

Committee on Noise as a Public Health Hazard (Minn. -- part of ASHA)

Deafness Research Foundation

Institute of Noise Control Engineers

International Society of Audiology

Military Audiology and Speech Pathology Society

National Association of Speech and Hearing Agencies

National Council of Acoustical Consultants (Mich.)

National Council on Noise Abatement

II. PROFESSIONAL ASSOCIATIONS (NON-AUDITORY) WITH SUBSTANTIAL INTERESTS AND/OR ACTIVITIES RELATED TO NOISE PROBLEMS

Air Conditioning and Refrigeration Institute

Air Moving and Conditioning Association

American Academy of Environmental Engineers

American Conference of Governmental Industrial Hygienists

American Council of Otolaryngology

American Diopter and Decibel Society

American Industrial Hygiene Association

American Insurance Association

American Iron and Steel Institute

American Laryngological, Rhinological, and Otological Society

American Medical Association

American Mutual Insurance Alliance

American National Standards Institute

American Otological Society

American Petroleum Institute

American Public Health Association

American Society of Heating, Refrigerating and Air Conditioning Engineers

American Society of Mechanical Engineers

American Society for Testing and Materials

American Trucking Association

Electronic Industries Association

Hearing Aid Industry Conference

Industrial Medical Association

Industrial Safety Equipment Association

Institute of Electrical and Electronic Engineers

Institute of Environmental Sciences

Institute of Heating and Air Conditioning Industries

Instrument Society of America

National Association of the Deaf

National Academy of Science

National Electrical Manufacturers Association

National Institute for Occupational Safety and Health

National Medical Association Foundation

National Safety Council

Society of Automotive Engineers

Society of Experimental Stress Analysis

Society of Motion Picture and Television Engineers

Society of Professional Engineers

Ultrasonic Manufacturers Association

III. OTHER PROFESSIONAL ASSOCIATIONS INTERESTED IN NOISE RELATED PROBLEMS

Academy of Model Aeronautics

Aerospace Industries Association of America

Aerospace Medical Association

Aircraft Owners and Pilots Association

Air Force Association

Air Line Pilots Association

Airport Operators Council International

Air Transport Association of America

Air Transportation Conferences National

Airways Engineering Society

American Academy of Occupational Medicine

American Association for the Advancement of Science

American Association for Health Physical Education and Recreation

American Association of Homebuilders

American Association of Motor Vehicle Administrators

American Association of State Highway Officials

American Astronautical Society

American Bar Association

American Foundrymen's Society

American Helicopter Society

American Institute of Architects

American Institute of Biological Sciences

American Institute of Planners

American Metal Stamping Association

American Motor Hotel Association

American Physiological Society

American Road Builders Association

American Society of Agricultural Engineers

American Society of Safety Engineers

American Textile Machinery Association

American Truckers Association

Association of American Railroads

Association of Home Appliance Manufacturers

Automobile Manufacturers Association

Automotive Parts and Accessories Association

Building Research Institute

Compressed Air and Gas Institute

Construction Industry Manufacturers Association

Consulting Engineers Council

Engine Manufacturers Association

Farm and Industrial Equipment Institute

Highway Users Federation for Safety and Mobility

Home Ventilating Institute

Institute for Rapid Transit

Lead Industry Association

Motor and Equipment Manufacturers Association

National Association of Home Builders

National Association of Human Rights Workers

National Audio-Visual Association

National Automatic Merchandising Association

National Biomedical Research Foundation

National Constructors Association

National Environmental Health Association

National Institute of Municipal Law Officers

National Pilots Association

Rail Foundation

Rubber Manufacturers Association

Transportation Association of America

IV. VOLUNTARY ANTI-NOISE ORGANIZATIONS

Citizens Against Noise

Citizens for a Quieter City

Citizens for a Quieter Environment, Inc.

Citizens League Against the Sonic Boom

National Organization to Insure a Sound Controlled Environment

Appendix B

CURRENT ANSI STANDARDS IN ACOUSTIC VIBRATION MECHANICAL SHOCK, AND SOUND RECORDING

Number	Title	Comments
S1.1-1960	Revision and Consolidation of Acoustical Terminology (Including Mechanical Shock and Vibration) Z24.1-1951 and Z24.1a	(Agrees with ISO R131) (ISO R16 and IEC 50-08)
S1.2-1962	Method for Physical Measurement of Sound	(Revision of Z24.7-1950)
S1.4-1961	Specification for General-Purpose Sound Level Meters	(Revision of Z24.3-1944) (IEC 123)
S1.5-1963	Practices for Loudspeaker Measurements	(61 IRE 30 RPI; IEEE 219-1961)
S1.6-1967	Preferred Frequencies and Band Numbers for Acoustical Measurements	(Agrees with ISO R266)
S1.7-1970	Method of Test for Sound Absorption of Acoustical Materials in Reverberation Rooms	(ASTM C423-66)
S1.8-1969	Preferred Reference Quantities for Acoustical Levels	
S1.10-1966	Method for the Calibration of Microphones	(Revision and Consolidation of Z24.4-1949 and Z24.11-1954)

( ) Indicates cross reference with ISO (International Organization for Standards) or IEC (International Electrotechnical Commission)

Number	Title	Comments
S1.11-1966	Specification for Octave, Half-Octave, and Third-Octave Band Filter Sets	(Revision and Redesignation of Z24.10-1953) (IEC 225)
S1.12-1967	Specifications for Laboratory Standard Microphones	(Revision and Redesignation of Z24.8-1949)
S2.2-1959	Methods for the Calibration of Shock and Vibration Pickups	
S2.3-1964 (R1970)	Specifications for a High-Impact Shock Machine for Electronic Devices	
S2.4-1960 (R1966)	Method for Specifying the Characteristics of Auxiliary Equipment for Shock and Vibration Measurements	
S2.5-1962	Recommendations for Specifying the Performance of Vibrating Machines	
S2.6-1963	Nomenclature and Symbols for Specifying the Mechanical Impedance of Structures	
S2.7-1964	Terminology for Balancing Rotating Machinery	
S2.10-1971	Methods for Analysis and Presentation of Shock and Vibration Data	
S2.11-1969	Selection of Calibrations and Tests for Electrical Transducers Used for Measuring Shock and Vibration	
S3.1-1960	Criteria for Background Noise in Audiometer Rooms	

Number	Title	Comments
S3.2-1960	Method for Measurement of Monosyllabic Word Intelligibility	
S3.3-1960	Methods for Measurement of Electroacoustical Characteristics of Hearing Aids	(IEC 118 and 126)
S3.4-1968	Procedure for the Computation of Loudness of Noise	(ISO R357)
S3.5-1969	Methods for the Calculation of the Articulation Index	
S3.6-1969	Specifications for Audiometers (Revision and Redesignation of Z24.5-1955, Z24.12-1952, and Z24.13-1953)	(IEC 177)
S3.8-1967	Method of Expressing Hearing Aid Performance	
S3-W-39	The Effects of Shock and Vibration on Man	
S4.1-1960	Methods of Calibration of Mechanically-Recorded Lateral Frequency Records	(58 IRE 19.S1; IEEE 192-1958)
S4.2-1966	Color Coding for Stereo Pick-up Leads	(EIA RS 243-1961)
Z24.5-1951		Revised and Redesignated as S3.6-1969
Z24.9-1949	Method for the Coupler Calibration of Earphones	
Z24.12-1952		Revised and Redesignated as S3.6-1969
Z24.13-1953		Revised and Redesignated as S3.6-1969

Number	Title	Comments
Z24.17-1955 (R1966)	Specification for the Design, Construction and Operation of Class HI (High-Impact) Shock-Testing Machine for Lightweight Equipment	
Z24.18-1956	Specification for Ultrasonic Therapeutic Equipment	
Z24.21-1957	Method for Specifying the Characteristics of Pickups for Shock and Vibration Measurement	
Z24.22-1957	Method for the Measurement of the Real-Ear Attenuation of Ear Protectors at Threshold	
Z24.24-1957	Procedures for Calibration of Electroacoustic Transducers (Particularly Those for Use in Water)	
Z24-X-2	The Relations of Hearing Loss to Noise Exposure	
Z57.1-1954	Methods for Determining Flutter Content of Sound Recorders and Reproducers	(53 IRE 19 S2; IEEE 193-1953)
Z57.4-1959	Requirements for Magnetic Recording Instruments for the Home — Wire Size, Speed, Spools	(EIA REC-131-A-1957)

Appendix C

DIRECTORY OF GRADUATE EDUCATION IN ACOUSTICS*

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Journal of the Acoustical Society of America. 49-, 442-476(1970)
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Directory of Graduate Education in Acoustics

WAYNE M. WRIGHT

Physics Department, Kalamazoo College, Kalamazoo, Michigan 49001

ARNOLD M. SMALL, JR.

Department of Speech Pathology and Audiology, The University of Iowa, Iowa City, Iowa 52240

RICHARD STERN

School of Engineering and Applied Science, University of California at Los Angeles, Los Angeles, California 90024

Institution and Contact for Information	Archit. Acoust.	Physiol. Acoust.	Psychol. Acoust.	Acoust. Instr. and Appar.	Musical Acoust.	Noise and Noise Control	Speech Commun.	Ultrasonics	Radiation and Scattering	Mech. Vib. and Shock	Underwater Sound	Aeroacoust., Macrosonics	Acoust. Signal Processing	Bioacoust.
•Colorado, Univ. of														
Boulder, Colo. 80302														
R. C. Chanaud (Civil and Environmental Engr.)	X					X								
R. Krug (Speech Path. and Audiology)			X				X							
P. Lynn (Civil and Environmental Engr.)										X				
•Columbia Univ., Teachers Coll.														
New York, N. Y. 10027														
I. M. Ventry (Speech Path. and Audiology)			X											
R. W. Woods (Speech Path. and Audiology)							X							
•Memphis State Univ.														
Memphis, Tenn. 38111														
J. L. Fletcher (Psychology)		X	X											X
A. J. Weston (Audiology and Speech Path.)							X							
•New York, City Univ. of														
33 W. 42 St., New York, N. Y. 10036														
A. J. Bronstein (The Graduate Center)							X							
•Pennsylvania, Univ. of														
Phila., Pa., 19104														
O. M. Salati (Electrical Engr.)	X	X		X	X									
F. Haber (Electrical Engr.)							X							
P. Edmonds (Electrical Engr.)								X						
M. Beran (Mechanical Engr.)									X					
•Syracuse Univ.														
Syracuse, N. Y. 13210														
M. Rothenberg (Electr. Engr. and Linguistics)							X							
•Tufts Univ.														
Medford, Mass. 02155														
F. C. Nelson (Mechanical Engr.)						X				X		X		
P. B. Sampson (Psychology)		X	X				X							
•Union College														
Schenectady, N. Y. 12308														
F. G. Haag (Mechanical Engr.)						X				X				
•Yale Univ.														
New Haven, Conn. 06520														
F. B. Tuteur (Engr. and Appl. Science)									X					
P. M. Schultheiss (Engr. and Appl. Science)											X		X	

• Indicates that PhD degree is awarded.

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Directory of Graduate Education in Acoustics

WAYNE M. WRIGHT
Physics Department, Kalamazoo College, Kalamazoo, Michigan 49001

ARNOLD M. SMALL, JR.
Department of Speech Pathology and Audiology, The University of Iowa, Iowa City, Iowa 52240

RICHARD STERN
School of Engineering and Applied Science, University of California at Los Angeles, Los Angeles, California 90024

One of the tasks assigned to the Society's Committee on Education in Acoustics is the gathering of data on the status of acoustics education in America. A recent activity in this area has centered on the compilation of a rather general summary of graduate programs. Such a summary should be of value in the advising of students seeking graduate study, as well as to the Committee and the Society.

Beginning in December of 1969, we sent a questionnaire to approximately 150 individuals who were thought to be engaged in acoustics education at the graduate level. Working with the response to this mailing, we have prepared a summary of present graduate programs in terms of activity within 14 different areas. These areas of acoustics study were taken from the list of major subject classifications of the *Journal of the Acoustical Society of America*. Although it generally can be assumed that some graduate thesis research is going on, the exact meaning of "graduate program" was left to the interpretation of each respondant. We did not specify that there should be a minimum number of formal courses or a formal acoustics degree program, and we did not request bibliographic evidence of recent research activity.

The following compilation is intended to include the names of all colleges and universities in the United States and Canada which provide graduate opportunities in at least one area of acoustics. For each program area, we include the name and address of one or more individuals who are personally cognizant of the activity and can be contacted for more detailed information. An address does not necessarily indicate the department in which the activity is carried on. Inclusion of the names of particular individuals was often rather arbitrary and, in general, was not meant to imply administrative responsibility or seniority.

It is recognized that this directory is not complete. In order that the anticipated revisions might be more accurate, we would greatly appreciate having readers notify one of us concerning any errors or omissions which might be found in this compilation.

Institution and Contact for Information	Archit. Acoust.	Physiol. Acoust.	Psychol. Acoust.	Acoust. Instr. and Appar.	Musical Acoust.	Noise and Noise Control	Speech Commun.	Ultrasonics	Radiation and Scattering	Mech. Vib. and Shock	Underwater Sound	Macrosonics, Aeroacoust.	Acoust. Signal Processing	Bioacoust.
*Air Force Inst. of Tech. Wright-Patterson AFB, Ohio 45433 P. J. Torvik (Mech.)										X				
*American University, The Washington, D. C. 20016 R. V. Waterhouse (Phys.) M. Harrison (Phys.)	X								X					
*Boston College Chestnut Hill, Mass. 02167 E. H. Carnevale (Phys.)								X				X		
*Bowling Green State Univ. Bowling Green, Ohio 43402 H. J. Greenberg (Speech) C. W. Koutstaal (Speech)			X				X							
*Brigham Young Univ. Provo, Utah 84601 W. J. Strong (Phys.)					X		X							
British Columbia, Univ. of Vancouver 8, B.C., Canada R. P. Gannon (Otolaryngol.) J. O. H. Ingling (Audiol. and Speech Sci.) J. H. Gilbert (Audiol. and Speech Sci.) A. P. Benguerel (Audiol. and Speech Sci.)		X	X				X X							
*Brown Univ. Providence, R. I. 02912 R. T. Beyer (Phys.) A. O. Williams (Phys.) P. J. Westervelt (Phys.) H. Kolsky (Appl. Math.) H. Dyer (Biomed. Sci.)								X		X	X	X		X

Institution and Contact for Information	Archit. Acoust.	Physiol. Acoust.	Psychol. Acoust.	Acoust. Instr. and Appar.	Musical Acoust.	Noise and Noise Control	Speech Commun.	Ultrasonics	Radiation and Scattering	Mech. Vib. and Shock	Underwater Sound	Macrosonics, Aeroacoust.	Acoust. Signal Processing	Bioacoust.
*Bryn Mawr College														
Bryn Mawr, Pa. 19010														
J. R. Olson (Phys.)								X						
*California, Univ. of														
Berkeley, Calif. 94720														
W. W. Soroka (Div. of Appl. Mech.)	X			X		X			X	X	X	X		
A. L. Leiman (Psychol.)		X												
E. R. Hafter (Psychol.)			X											
W. S-Y. Wang (Linguistics)							X							
R. M. White (Elec. Engr.)								X						
*California, Univ. of														
Los Angeles, Calif. 90024														
E. C. Carterette (Psychol.)		X	X				X							
W. J. Dowling III (Psychol.)					X									
I. Rudnick (Phys.)								X						
R. Stern (Mech. and Structures)								X			X			X
W. C. Meecham (Mech. and Structures)									X			X		
R. B. Matthiesen (Mech. and Structures)										X				
*California, Univ. of														
San Diego, Calif. 92152														
V. C. Anderson (Appl. Phys.)				X				X	X		X		X	
California State College														
Long Beach, Calif. 90801														
B. A. Landes (Speech)		X	X											
H. Unt (Mech. Engr.)				X		X				X				
J. J. Thompson (Speech)							X							
A. MacMillan (Elec. Engr.)											X			
B. H. Carpenter (Biology)														X
California State College														
Los Angeles, Calif. 90032														
D. R. Perrott (Psychol.)			X											
*Case Western Reserve Univ.														
Cleveland, Ohio 44106														
R. Shankland (Phys.)	X													
A. H. Benade (Phys.)					X									
P. H. Ptacek (Speech Commun.)							X							
E. Yeager (Chem.)								X						
A. Sokollu (Med. School—Surgery)														X
*Catholic Univ. of America														
Washington, D. C. 20017														
F. A. Andrews (Mech. Engr.) Chm. of the Acoust. Program				X		X		X	X	X	X		X	
P. Laura (Mech. Engr.)									X	X				
J. Gilheany (Mech. Engr.)				X							X			
E. Magrab (Mech. Engr.)				X						X				
T. Smits (Elec. Engr.)													X	
H. Uberall (Phys.)									X		X			
T. Litovitz (Phys.)								X						
T. Eisler (Space Sci.)									X					
*Colorado State Univ.														
Fort Collins, Colo. 80521														
S. W. Marshall (Phys.)											X			
*Columbia Univ.														
New York, N. Y. 10027														
C. M. Harris (Elec. Engr.)	X			X		X								
J. Tonndorf (Col. of Physicians. and Surg.)		X												
E. Galanter (Psychol.)			X											
V. Ussachevsky (Music)					X									
H. Deresiewicz (Mech. Engr.)										X				
M. Friedman (Civil Engr. and Appl. Mech.)												X		
*Denver, Univ. of														
Denver, Colo. 80210														
R. C. Amme (Phys.)								X						
H. S. Glick (Mech. Sci. and Envir. Engr.)												X		
H. C. Peterson (Mech. Sci. and Envir. Engr.)										X				
*Duke Univ.														
Durham, N. C. 27706														
J. N. Macduff (Mech. Engr.)						X				X				

Institution and Contact for Information	Archit. Acoust.	Physiol. Acoust.	Psychol. Acoust.	Acoust. Instr. and Apparatus	Musical Acoust.	Noise and Noise Control	Speech Commun.	Ultrasonics	Radiation and Scattering	Mech. Vib. and Shock	Underwater Sound	Macrosonics, Aeroacoust.	Acoust. Signal Processing	Bioacoust.
*Florida, Univ. of														
Gainesville, Fla. 32601														
B. Y. Kinzey, Jr. (Archit.)	x													
D. C. Teas (Speech/Psychol.)		x												
J. F. Brandt (Speech)			x											
A. Paige (Speech)				x			x							
C. C. Oliver (Mech. Engr.)				x		x					x	x	x	
J. Mahig (Mech. Engr.)										x				
Florida Atlantic Univ.														
Boca Raton, Fla. 33432														
E. F. Cox (Ocean Engr.)										x				
J. B. Davidson (Ocean Engr.)											x		x	
George Washington Univ.														
Washington, D. C. 20006														
S. E. Wright (Engr. Mech.)		x	x	x		x		x		x		x		
*Georgetown Univ.														
Washington, D. C. 20007														
W. G. Mayer (Phys.)								x	x	x				
*Georgia Inst. of Tech.														
Atlanta, Ga. 30332														
M. E. Raville (School of Engr. Sci. and Mech.)										x				
*Harvard Univ.														
Cambridge, Mass. 02138														
S. S. Stevens (Psychol.)				x										
G. Holton (Phys.)								x						
S. A. Benton (Div. Engr. and Appl. Phys.)									x					
R. E. Kronauer (Div. Engr. and Appl. Phys.)										x	x	x		
*Hawaii, Univ. of														
Honolulu, Hawaii 96822														
J. Burgess (Mech. Engr.)						x								
A. Parvulescu (Ocean Engr.)											x			
F. Koide (Elec. Engr.)														x
G. Fang (Elec. Engr.)													x	
*Houston, Univ. of														
Houston, Texas 77004														
R. W. Wendahl (Speech Path. and Audiol.)							x							
B. D. Cook (Mech. Engr.)						x		x						x
D. Muster (Mech. Engr.)						x				x	x			
R. D. Finch (Mech. Engr.)								x		x	x			
H. S. Hayre (Elec. Engr.)									x		x			
*Illinois, Univ. of														
Urbana, Ill. 61801														
H. Ades (Biophys.)		x												
G. Z. Greenberg (Psychol.)			x											
D. H. Cooper (Elec. Engr.)				x		x								
J. W. Beauchamp (Elec. Engr.)								x						x
F. Dunn (Elec. Engr.)									x					
G. W. Swenson, Jr. (Elec. Engr.)							x						x	
M. L. Babcock (Elec. Engr.)						x								
J. J. O'Neill (Speech)		x					x							
W. R. Zemlin (Speech)										x				
R. A. Eubanks (Civil Engr.)														
*Iowa, The Univ. of														
Iowa City, Iowa 52240														
J. Wernick (Speech Path. and Audiol.)		x												
A. M. Small (Speech Path. and Audiol.)			x											
K. Moll (Speech Path. and Audiol.)								x						
D. Lilly (Speech Path. and Audiol.)														x
W. Savage (Phys.)						x								
John Carroll Univ.														
Cleveland, Ohio 44118														
E. F. Carome (Phys.)									x	x				
*John Hopkins Univ.														
Baltimore, Md. 21205														
M. H. Goldstein (Elect. Engr.)		x						x						
J. M. Heinz (Laryngol. and Otol.)											x			
E. R. Fitzgerald (Mech.)														

Institution and Contact for Information	Archit. Acoust.	Physiol. Acoust.	Psychol. Acoust.	Acoust. Instr. and Appar.	Musical Acoust.	Noise and Noise Control	Speech Common.	Ultrasonics	Radiation and Scattering	Mech. Vib. and Shock	Underwater Sound	Macrosonics, Aeroacoust.	Acoust. Signal Processing	Bioacoust.
*Kansas Univ. Medical Center Kansas City, Kansas 66103														
P. S. Toledo (ENT)		x												
R. Heady (Surgery)				x										
C. P. Goetzinger (ENT—Audiol.)						x								
H. Odoi (ENT—Audiol.)														x
R. L. Shelton, Jr. (Speech and Hearing)							x							
Louisiana Polytechnic Inst. Ruston, La. 71270														
R. F. Barron (Mech. Engr.)						x								
G. J. Trammell (Mech. Engr.)										x				
*Massachusetts, Univ. of Amherst, Mass. 01002														
I. B. Thomas (Elec. Engr.)		x	x				x						x	
C. E. Hutchinson (Elec. Engr.)											x			
R. Mani (Mech. Engr.)						x								
*Massachusetts Inst. of Tech. Cambridge, Mass. 02139														
R. B. Newman (Archit.)	x													
M. Eden (Elec. Engr.)			x											
A. G. Bose (Elec. Engr.)				x										
K. N. Stevens (Elec. Engr.)							x							
W. A. Rosenblith (Elec. Engr.)														x
U. Ingard (Phys.)								x	x			x		
S. H. Crandall (Mech. Engr.)					x					x				
R. H. Lyon (Mech. Engr.)						x								
A. D. Pierce (Mech. Engr.)									x			x		
R. Salant (Mech. Engr.)				x										
P. R. Lele (Mech. Engr.)								x						
J. L. Kerrebrock (Aero. and Astro.)						x								
P. Leehey (Naval Archit.)											x			
Miami, Univ. of Miami, Fla. 33149														
J. C. Steinberg (Ocean Engr.)											x			
N. L. Weinberg (Ocean Engr.)											x		x	
*Michigan, Univ. of Ann Arbor, Mich. 48104														
J. W. Hawkins, Jr. (Program in Physicl. Acoust.)		x												
*Minnesota, Univ. of Minneapolis, Minn. 55455														
W. D. Ward (Otlaryngl.)		x	x											
R. F. Lambert (Elec. Engr.)				x					x				x	
C. Speaks (Speech and Hearing Sci.)							x							
R. Plunkett (Aeron. Engr.)										x				
*Mississippi, Univ. of University, Miss. 38677														
F. D. Shields (Phys.)								x						
Missouri at Rolla, Univ. of Rolla, Mo. 65401														
W. S. Gatley (Mech. and Aerosp. Engr.)	x			x		x				x				
Murray State Univ. Murray, Kentucky 42071														
W. R. Klein (Phys.)								x						
*Naval Postgraduate School Monterey, Calif. 93940														
G. Sackman (Elec. Engr.)				x									x	
O. B. Wilson (Phys.)								x						
H. Medwin (Phys.)									x		x			
A. B. Coppens (Phys.)												x		
T. H. Houlihan (Mech. Engr.)										x				
*Nevada, Univ. of Reno, Nevada 89507														
R. A. Manhart (Elec. Engr.)						x	x	x					x	x
*New Hampshire, Univ. of Durham, N. H. 03824														
A. D. Frost (Elec. Engr.)				x									x	
F. H. Glanz (Elec. Engr.)											x			

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*New Mexico State Univ.														
Las Cruces, N. M. 88001														
D. Hunt (Psychol.)			X											
E. Garrett (Speech)							X							
N. Byers (Mech. Engr.)										X				
*New York at Buffalo, State Univ. of														
Buffalo, N. Y. 14226														
L. K. Moulin (Speech)			X											
R. E. McGlone (Speech)							X							
F. P. Fischer (Elec. Engr.)								X					X	
N. M. Isada (Mech. Engr.)										X				
D. M. Benenson (Interdisc. Studies)												X		
*North Carolina State Univ.														
Raleigh, N. C. 27607														
W. G. Thomas (Surgery, Univ. N. C., Chapel Hill)		X												
R. G. Pearson (Indus. Engr.)			X											
F. D. Hart (Mech. and Aerosp. Engr.)				X		X				X		X		
J. Woodburn (Mech. and Aerosp. Engr.)								X						
L. H. Royster (Mech. and Aerosp. Engr.)				X		X			X		X			
North Dakota, Univ. of														
Grand Forks, N. D. 58201														
P. J. Reiten (Mech. Engr.)	X					X								
A. E. Anuta (Mech. Engr.)										X				
*Northeastern Univ.														
Boston, Mass. 02115														
W. J. Remillard (Elec. Engr.)	X										X	X		
B. Scharf (Psychol.)			X											
L. Dolansky (Elec. Engr.)							X							
*Northwestern Univ.														
Evanston, Ill. 60201														
P. Dallos (Elec. Engr.)		X												
R. Carhart (Audiol.)			X											X
W. O. Olsen (Audiol.)							X							
J. E. Jacobs (Elec. Engr.)				X										
M. Epstein (Elec. Engr.)								X						
E. Hermann (Civil Engr.)						X								
L. M. Keer (Civil Engr.)										X				
D. Mintzer (Mech. Engr.)											X			
*Notre Dame, Univ. of														
Notre Dame, Ind. 46556														
R. M. Brach (Aerosp. and Mech. Engr.)	X					X				X				
Nova Scotia Technical College														
Halifax, Nova Scotia, Canada														
S. N. Sarwal (Appl. Math.)											X			
O. Cochkanoff (Mech. Engr.)	X													
O. K. Gashus (Elec. Engr.)													X	
D. A. Winter (Elec. Engr.)														X
*Ohio Univ.														
Athens, Ohio 45701														
J. Shallop (Hearing and Speech Sci.)							X							
F. B. Stumpf (Phys.)								X	X					
*Ohio State Univ., The														
Columbus, Ohio 43210														
S. M. Marco (Mech. Engr.)						X								
K. Graff (Engr. Mech.)										X				
*Oklahoma Medical Center, Univ. of														
Oklahoma City, Okla. 73104														
G. A. Studebaker (Commun. Disorders)			X											
*Oklahoma State Univ.														
Stillwater, Okla. 74074														
T. Dean (Archit.)	X													
R. Lowery (Mech. Engr.)						X			X	X				
T. G. Winter (Phys.)								X						
*Oregon Medical School, Univ. of														
Portland, Oregon 97201														
A. R. Tunturi (Anatomy)		X												

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*Pennsylvania State Univ., The														
State College, Pa. 16801														
H. F. Kingsbury (Archit. Engr.)	X													
P. L. Michael (Speech Pathol.)		X												
R. B. Freeman (Psychol.)			X											
F. W. Boggs (Engr. Acoustics), Chairman, Interdisc. Prog. in Engr. Acoust.)				X										
R. O. Rowlands (Engr. Acoust.)													X	
G. Reethof (Mech. Engr.)						X								
R. S. Brubaker (Speech)							X							
E. J. Skudrzyk (Phys.)								X	X					
V. H. Neubert (Engr. Mech.)										X				
R. W. Farwell (Ordnance Res. Lab.)											X			
M. Sevik (Aerosp. Engr.)												X		
G. K. Strother (Biophys.)														X
*Pittsburgh Medical Sch., Univ. of														
Pittsburgh, Pa. 15213														
L. G. Doerfler (Audiol.)		X	X											X
*Princeton Univ.														
Princeton, N. J. 08540														
E. G. Wever (Psychol.)		X												X
R. A. Kinchla (Psychol.)			X											
*Purdue Univ.														
Lafayette, Ind. 47907														
T. L. Langford (Psychol.)		X												
R. D. Sorkin (Psychol.)			X											
M. J. Crocker (Mech. Engr.)						X								
R. Cohen (Mech. Engr.)										X				
G. W. Hughes (Elec. Engr.)							X						X	
*Queens College, CUNY														
Flushing, N. Y. 11367														
L. Deutsch (Commun. Arts and Sci.)		X	X											
J. B. Newman (Commun. Arts and Sci.)							X							
L. Diesendruck (Phys.)											X			
*Rhode Island, Univ. of														
Kingston, R. I. 02881														
H. Etsold (Elec. Engr.)	X			X	X									
F. H. Middleton (Ocean Engr.)		X						X	X		X		X	X
F. T. Dietz (Phys.)				X							X		X	
S. V. Letcher (Phys.)								X						
F. White (Mech. Engr.)										X				
H. Winn (Grad. Sch. of Oceanography)														X
*Rochester, Univ. of														
Rochester, N. Y. 14627														
H. B. Voelcker (Elec. Engr.)			X								X			
H. G. Flynn (Elec. Engr.)														
E. L. Carstensen (Elec. Engr.)														X
E. H. Jacobsen (Phys.)								X						
San Jose State College														
San Jose, Calif. 95114														
W. W. Seto (Mech. Engr.)										X				
*Southern California, Univ. of														
Los Angeles, Calif. 90007														
J. Backus (Phys.)					X									
*Southern Mississippi, Univ. of														
Hattiesburg, Miss. 39401														
R. B. Mahaffey (Speech and Hearing Sci.)			X	X			X							
R. Rhodes (Speech and Hearing Sci.)						X	X							
*Stanford Univ.														
Stanford, Calif. 94305														
J. H. Dewson (Speech and Hearing Sci.)		X												
E. D. Schubert (Speech and Hearing Sci.)			X											
D. A. Huntington (Speech and Hearing Sci.)							X							
C. F. Quate (Appl. Phys.)								X						

Institution and Contact for Information	Archit. Acoust.	Physiol. Acoust.	Psychol. Acoust.	Acoust. Instr. and Appar.	Musical Acoust.	Noise and Noise Control	Speech Commun.	Ultrasonics	Radiation and Scattering	Mech. Vib. and Shock	Underwater Sound	Macrosonics, Aeroacoust.	Acoust. Signal Processing	Bioacoust.
*Stevens Institute of Tech.														
Hoboken, N. J. 07030														
E. M. Arase (Ocean Engr.)									X		X			
T. Arase (Ocean Engr.)													X	
F. Sisto (Mech. Engr.)										X				
F. Pollock (Phys.)									X					
*Syracuse Univ.														
Syracuse, N. Y. 13210														
W. B. Adams (Lab. of Sensory Commun.)		X												
J. J. Zwislocki (Lab. of Sensory Commun.)			X											
*Tennessee, Univ. of														
Knoxville, Tenn. 37916														
H. L. Luper (Audiol. and Speech Pathol.)		X					X							
M. A. Breazeale (Phys.)								X						
T. G. Carley (Engr. Mech.)										X				
Tennessee Technological Univ.														
Cookeville, Tenn. 38501														
W. S. Mitchell (Mech. Engr.)										X	X			
K. R. Purdy (Mech. Engr.)												X		
*Texas at Austin, Univ. of														
Austin, Texas 78712														
L. L. Copra (Speech)		X					X							
C. P. Boner (Archit.)	X													
L. A. Jeffress (Psychol.)			X											
E. L. Hixson (Elec. Engr.)				X		X		X		X	X		X	
G. J. Gruber (Mech. Engr.)				X		X		X	X	X	X		X	
G. B. Thurston (Mech. Engr.)														X
C. W. Horton (Phys.)									X				X	
*Toronto, Univ. of														
Toronto 5, Canada														
H. S. Ribner (Inst. for Aerosp. Studies)						X			X			X	X	
Toronto 181, Canada														
C. D. Creelman (Psychol.)			X											
*Vanderbilt Univ.														
Nashville, Tenn. 37203														
R. T. Lagemann (Phys. and Astron.)								X						
*Vermont, Univ. of														
Burlington, Vt. 05401														
A. Chambers (Physiol.)		X												
W. Patterson (Psychol.)			X											
W. Roth (Elec. Engr.)				X										
T. D. Sachs (Phys.)								X			X			
W. L. Nyborg (Phys.)								X				X		X
*Virginia, Medical College of														
Richmond, Va. 23219														
S. F. Cleary (Biophys.)														X
*Washington U., Central Inst. for the Deaf														
St. Louis, Mo. 63110														
D. H. Eldredge (Speech and Hearing)		X												
J. D. Miller (Psychol.)			X											
A. F. Niemoeller (Elec. Engr.)													X	
*Washington, Univ. of														
Seattle, Wash. 98105														
G. D. White (Audio Visual Services)	X				X									
J. M. Miller (Otolaryngol.)		X												
J. P. Egan (Psychol.)			X											
W. R. Tiffany (Speech)							X							
A. W. Guy (Phys. Med. and Rehabil.)								X						
R. Sigelmann (Elec. Engr.)									X					
J. H. Harris (Elec. Engr.)													X	
S. Murphy (Div. Marine Resources)											X			
J. M. Reid (Physiol. and Biophys.)														X
H. C. Merchant (Mech. Engr.)										X				
J. D. Chalupnik (Mech. Engr. and Multidisciplinary Acoust. Prog.)				X		X								

Institution and Contact for Information	Archit. Acoust.	Physiol. Acoust.	Psychol. Acoust.	Acoust. Instr. and Apper.	Musical Acoust.	Noise and Noise Control	Speech Commun.	Ultrasonics	Radiation and Scattering	Mech. Vib. and Shock	Underwater Sound	Macrosonics, Aeroacoust.	Acoust. Signal Processing	Bioacoust.
*Waterloo, Univ. of														
Waterloo, Ontario, Canada														
J. S. Keeler (Elec. Engr.)				X	X	X							X	
*Wayne State Univ.														
Detroit, Mich. 48202														
D. N. Elliot (Psychol.)			X											
R. L. Thomas (Phys.)								X					X	
West Virginia Univ.														
Morgantown, W. Va. 26506														
W. T. Brandy (Speech Pathol. and Audiol.)			X			X							X	X
N. J. Lass (Speech Pathol. and Audiol.)			X	X			X							
*Wisconsin, Univ. of														
Madison, Wisc. 53706														
J. Miller (Elec. Engr.)				X		X								
J. Harries (Linguistics)							X							
C. S. Clay (Geol. and Geophys.)									X		X		X	
T. C. Huang (Engr. Mech.)										X				
*Woods Hole Oceanographic Inst.														
Woods Hole, Mass. 02543														
Chairman (Geol. and Geophys.)											X			

*Indicates that PhD degree is awarded.

Appendix D

UNIVERSITY GRADUATE COURSES WITH MAJOR CONTENT IN ACOUSTICS*

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Education in Acoustics

Editorial Note: The following two notes with accompanying statistical data represent the results of recent activity of the Committee on Education in Acoustics of the Acoustical Society of America. It has been felt that it would be helpful to the acoustics community to bring up to date the data presented in the earlier report "Proceedings of the Conference on Education in Acoustics," J. Acoust. Soc. Amer. 37, 357–381 (1965) *and to add to these a special section on graduate programs in acoustics.*

Availability of Formal Courses in Acoustics in Colleges and Universities

JOHN C. JOHNSON

Ordnance Research Laboratory, The Pennsylvania State University, University Park, Pennsylvania

Access to programs and courses in educational institutions becomes especially important when one is considering a field in which the availability is particularly limited. Such is the case for the field of acoustics. The information given here on courses having major acoustics content was furnished by members of the Acoustical Society of America during the period 15 January–8 May 1970. Of the 675 courses reported, 259 are available to undergraduates and 474 to graduates. The current listing of courses includes all reported offerings, regardless of type of administering units, i.e., departments, committees, continuing education, etc.

Introduction: A special conference, Education in Acoustics, was held at the American Institute of Physics, 12–13 March 1964, for the purpose of evaluating the role and significance of the subject matter of acoustics in higher education and to chart the future of education in acoustics. The report on the proceedings of that conference[1] contained, as an appendix, a listing of courses with acoustics content in PhD granting institutions. The courses listed were identified in catalogues issued by those institutions. With very few exceptions, only those courses offered by engineering colleges and physics departments were reported. Since that time, the ASA administrative Committee on Education in Acoustics has made a number of attempts to update the 1964 listing of courses.

Following the 1969 Fall Meeting of the Acoustical Society of America, it was decided to attempt to collect data on current course offerings in acoustics as a part of a broader survey, which included information on acoustic programs, research activities, and manpower needs. During this same period, the Committee on Education in Acoustics pursued collection of information on acoustic programs. The simultaneous completion of the two surveys permitted a cross-check on sources of acoustic programs, and the result can be found under the Committee report. The information on research activities and manpower needs was motivated primarily by the ASEE Committee on Education in Acoustics, however, it will also be made available to all members of the Acoustical Society of America.

Summary of Acoustic Course Survey: Whereas previous surveys on acoustic course offerings have used catalogues as the resource, it was concluded to be worthwhile to obtain such material directly from those having a primary interest in the field. In order to minimize the possibility of overlooking appropriate contributors, a request was directed to all members of the Acoustical Society of America. This permitted each individual to use his own judgment as to which courses have major acoustic content. This becomes important in many courses which are for multipurpose objectives.

The response to the request for information was quite gratifying for the most part. The total number of individual responses as of 8 May was 830. It was pointed out by several respondents that they were reporting for a number of others in their organizations. On the other hand, there were a few cases where no report was made, even though their institutions have course offerings.

Of particular interest to educators should be the apparent trends in changes in acoustic education since the 1964 survey. It is important to note that such trends can only be described as apparent, because of the grossly different means of data collection. One of the striking differences is that in 1964 more than 60 physics departments had reported courses, while in 1970 there were less than 40 such departments reporting. Even more striking is the drop in the number of mechanical engineering departments from 65 in 1964 to 23 in 1970. Engineering mechanics departments also dropped sharply from 26 to 6. Even with these major changes, it should be noted that the total number of engineering departments reported as having acoustic courses approximated 120 for both reports.

A comparison of the 1964 and 1970 surveys shows that there were 39 institutions listed in the earlier survey for which no report was received in the latter. Conversely, the 1970 survey included 60 institutions which were not included in the 1964 report. These were made up of 26 with science and engineering courses, 13 with nonscience and nonengineering courses, 14 not in the United States, and 7 miscellaneous. In 1964, courses from 195 departments were included and in 1970, 251 departments (or programs).

This report should be of particular benefit to students and counselors alike by providing guidance on choice of institutions for study in acoustics. Also, it fortunately provides information for nonscience and nonengineering fields. For example, it reports on 40 speech, 20 psychology, and 20 architecture departments which were not in the previous report. There are also a number of new departments reported such as ocean engineering, acoustics, and various biological and medical programs.

In summary, the results of this survey were quite satisfactory. Although omissions are known to exist, a report of this type can never expect to be completely accurate. It is presumed that corrections will be received and these can be noted in a later issue of the JOURNAL.

Acknowledgments: The author expresses his gratitude to Dr. R. Bruce Lindsay and Dr. Gerhard Reethof for their encouragement and advice leading to this report. Also, thanks are due to Mr. Jess E. Rollin and Mr. Robert C. Price and their staffs for providing assistance in handling the data and preparing it for publication.

[1] R. Bruce Lindsay, "Proceedings of the Conference on Education in Acoustics," J. Acoust. Soc. Amer. 37, 357–381 (1965).

Courses with Major Acoustics Content

INSTITUTION	DEPARTMENT	LEVEL Under-grad.	LEVEL Grad.	CREDIT HOURS	COURSE TITLE	DESCRIPTION WHERE PROVIDED AND PERTINENT
Adelphi Univ.	Phys.		X	3	Sonar Fundamentals	Underwater acoustics and basic sonar concepts
			X	3	Sonar Systems	Shipboard and airborne sonar system design problems; shallow and deep water acoustic path, signal processing and correlation techniques, and sonar performance prediction
American Univ.	Phys.	X		3	Acoustics	
			X	3	Waves and Vibrations	
Amherst Coll.	Phys.	X		4	Wave Phenomena	General characteristics of wave motion approached through wave equation and solution to boundary value problems
Ariz., Univ. of	Speech		X	3	Theories of Hearing	Psychoacoustics
			X	3	Experimental Audiology	Physiological acoustics
			X	3	Seminar in Experimental Audiology	Physiological acoustics
Baldwin-Wallace Coll.	Phys.	X		5	Acoustics	Basic acoustics for nonscience majors, especially musicians; instruments, voice, ears, rooms, noise
Baylor Univ.	Psych.		X	3	Behavioral Effects of Noise	
Bowling Green State Univ.	Phys.	X		5	Acoustics and Ultrasonics	Survey course
	Speech Path. and Audiology	X		4	Phonetics	Basic course in speech production and transcription
		X		4	Advanced Phonetics	Basic course in instrumentation for measuring speech parameter
			X	4	Acoustic Phonetics	Speech perception
			X	4	Physiological Phonetics	Speech production
Brigham Young Univ.	Elec. Eng.	X	X	2	Elements of Acoustics	Sound production, transmission, and reception and applications to physical acoustics
			X	3	Architectural Acoustics	Behavior of sound in rooms, with applications
	Phys.	X		3	Descriptive Acoustics of Music and Speech	General education course for nonscience students in music and speech
		X	X	4	Fundamentals of Acoustics	General consideration of generation, transmission, and reception of acoustic energy
		X	X	2	Acoustical Measurements	Selected experiments to parallel above course
			X	3	Characteristics of Speech	Acoustic theory of speech production, analysis, synthesis, and recognition
			X	3	Musical Acoustics	Study of acoustical behavior of musical instruments; analysis-synthesis of tones; mathematical models
British Columbia, Univ. of	Audiology and Speech Sci.		X	3	Experimental Phonetics	Speech production
			X	3	Advanced Phonetics	Speech perception
			X	3	Experimental Audiology	Psychoacoustics
			X	3	Advanced Audiology	Bioacoustics
Brown Univ.	Phys.		X	4	Ultrasonics	Use of ultrasonics in physical acoustics for investigating the properties of gases, liquids, and solids
			X	4	Nonlinear Acoustics	
			X		Finite Amplitude Acoustics	Introductory course
Calif. State Coll. Long Beach	Elec. Eng.	X		3,1	Underwater Sonics	Analysis of distributed parameter systems; wave generation, propagation, and detection; laboratory measurement of sonic performance

Courses with Major Acoustics Content—Continued

INSTITUTION	DEPARTMENT	LEVEL Under-grad.	LEVEL Grad.	CREDIT HOURS	COURSE TITLE	DESCRIPTION WHERE PROVIDED AND PERTINENT
Long Beach (continued)		X		3	Underwater Sonics II	Application of sonic principles to engineering problems; directional arrays and detectors
	Mech. Eng.	X	X	3	Engineering Acoustics	Theory and application of acoustical principles to generation, transmission, measurement, and control of sound
Los Angeles	Psych.	X		4	Theories of Sensation and Perception	
		X		4	Experimental Sensation and Perception	
			X	4	Seminar in Sensation and Perception	
Calif., Univ. of Berkeley	Appl. Mech.	X		3	Fundamentals of Acoustics	
		X		3	Acoustical Environment Control	Noise measurements and control
		X		3	Mechanical Vibrations	Introductory course in mechanical vibrations
			X	4	Linear Oscillations	Advanced course
			X	3	Random Oscillations	
	Civil Eng.		X	3	Three-Dimensional Dynamic Problems in Linear Solids	Wave propagation in linear materials, elastic, and viscoelastic
			X	3	Mechanics of Solids	Wave propagation in plastic and viscoplastic materials
	Psych.	X		5	Perception	Auditory psychophysics and physiology
			X	3	Seminar in Perception	Binaural hearing
Irvine	Social Sci.	X		4	Mathematical Psychology	Introduction to mathematical models in psychology by examples from auditory psychophysics
Los Angeles	Eng.	X		4	Engineering Acoustics	General acoustics—wave equations; aeroacoustics
			X	4	Fundamentals of Aeroacoustics	Acoustic theory—aero sound—Lighthill's development
			X	4	Advanced Topics in Aero-acoustics	Noise generation by turbulent and supersonic flow from jets, rockets
			X	4	Advanced Topics in Engineering Acoustics	Noise control, underwater acoustics, ultrasonic propagation
			X	4	Sound and Vibration	Acoustically induced vibrations, transmission loss in structures
	Extension	—	—	6	Fundamentals of Shock, Vibration, and Noise Protection	
	Linguistics		X	4	Seminar in Acoustic Phonetics	
			X	4	Experimental Methods in Linguistics	Half of course devoted to acoustics of speech
	Phys.	X		4	Mechanics of Wave Motion and Sound	Vibrating systems and wave propagation in gases, liquids, and solids; architectural acoustics
			X	4	Advanced Acoustics A	Propagation of waves in elastic and fluid media; reflection, refraction, defraction, and scattering of waves in fluids
			X	4	Advanced Acoustics B	Propagation in nonhomogeneous fluids and in moving fluids
			X	4	Seminar in Advanced Physical Acoustics	
			X	4	Seminar in Propagation of Waves in Fluids	
			X	4	Acoustics Laboratory	
	Psych. and Music	X		4	Psychology of Music A	Physics of musical sound, psychology of audition
		X		4	Psychology of Music B	Musical syntax, social psychology and sociology of music

Courses with Major Acoustics Content—Continued

INSTITUTION	DEPARTMENT	LEVEL Under-grad.	LEVEL Grad.	CREDIT HOURS	COURSE TITLE	DESCRIPTION WHERE PROVIDED AND PERTINENT
San Diego	Appl. Phys. and Information Sci.	X		3	Introduction to Acoustics	Vibrating strings, bars, membranes, plates; transmission of acoustic waves; transducers, speech, hearing; architectural and underwater acoustics
			X	3	Acoustics	Same as above
			X	2	Acoustic Signal Processing	Analog and digital beam-forming methods; correlation techniques; background and signal statistics
Santa Barbara	Speech	X		4	Speech Science	Acoustic and physiological bases for an understanding of the speech and hearing mechanisms
		X		4	Introduction to Audiology	Fundamentals of acoustics; anatomy and physiology of the hearing mechanism
		X		3	Auditory Communication for the Hard of Hearing	The design and use of hearing aids, auditory trainers, and group instruments
		X		4	Identification Audiometry	Introduction to clinical audiometry; training and supervised practice
			X	4,4	Experimental Phonetics	Critical examination of foundations for current procedures in evaluation and description of vocal communication
			X	4	Experimental Studies in Hearing	Application of experimental methods to the study of auditory processes, particularly speech perception
			X	5	Advanced Audiology	Study of selected topics in audiology; signal detection, binaural hearing; automatic audiometry, electrophysiology
			X	3	Theories of Hearing	Historical review of auditory theories with emphasis on current theories of cochlear and retrocochlear processes
Carnegie–Mellon Univ.	Elec. Eng.	X		4	Fields, Waves, and Transmission Lines	Special emphasis on acoustical, fluid, and mechanical analogies
		X		6	Engineering Analysis	The analysis of engineering problems, including acoustics
			X	6	Graduate Engineering Analysis	
Case Western Reserve Univ.	Speech Communication		X	3	Speech Science	Analysis and measurement of speech production
			X	3	Hearing Science	Analysis of auditory behavior and its modification, psychoacoustics and bioacoustics
			X	3	Acoustic Phonetics	Characteristics of speech sounds; acoustical theory and methods of analysis in phonetics; research projects
			X	3	Bioacoustics	Physiological acoustics; concepts in audiology; techniques of research
			X	3	Psychoacoustics	Principles of psychoacoustics; audiological tests; review of research techniques
Catholic Univ. of Amer.	Mech. Eng.		X	3	Theory of Waves	Simple sound radiators, geometrical radiation theory, diffraction of scalar waves
			X	3	Principles of Underwater Sound	Sonar equations and parameters, and propagation in the sea
			X	3	Underwater Sound Propagation	Acoustic oceanography, ray tracing, convergence zones, ducts, mixed layer, ocean sound channel, shallow-water sound propagation, bottom and surface reflections
			X	2	Electromechanical Circuits and Transducers	Design of transducers, equivalent circuits of piezoelectric transducers
			X	3,3	Theoretical Acoustics	
			X	2,2	Special Topics in Advanced Acoustics	Creeping waves, sound generation by turbulence, interaction of light and sound, sound propagation
			X	3,3	Random Signal Theory or Statistical Communications Theory	Signal processing; probability theory; time and ensemble averages; correlations; sampling theory; optimum filters, prediction, and decision theory

Courses with Major Acoustics Content—Continued

INSTITUTION	DEPARTMENT	LEVEL Under-grad.	LEVEL Grad.	CREDIT HOURS	COURSE TITLE	DESCRIPTION WHERE PROVIDED AND PERTINENT
Chicago, Univ. of	Linguistics	X	X	3	Phonetics	General treatment of the field including acoustic phonetics
Cincinnati, Univ. of	Architect.	X		2	Environmental Technology	Portion of course devoted to architectural acoustics
	Math. and Mech.		X	3	Theory of Vibrations	
	Mech. Eng.	X		4	Mechanical Vibrations I	Vibrational systems, lab, and simulation
		X	X	4	Mechanical Vibrations II	Lumped parameter and elastic bodies, mechanical transients
	Music Theory	X	X	6	Musical Acoustics	Concepts of musical acoustics; musical instruments and tones; musical hearing, environment, electroacoustics, and electronics
	Speech and Theatre		X	3	Auditory Processes	Audition system: sender, receiver, transmission
			X	3	Experimental Audiology	Classic studies in speech perception, masking
			X	3	Research Instrumentation in Audiology	Seminar studies in research instrumentation with emphasis on computer control
City Univ. of New York	Communication Arts and Sci.	X		3	Introduction to Hearing Science	Introduction to audition; structure and function of the auditory system; basic parameters
		X		3	Introduction to Speech Science	Acoustical components of speech and their physiological correlates
			X	6	Experimental Acoustic Phonetics	Acoustic and phonetic analysis of the production of speech
			X	3	Physiological and Psychological Acoustics	
	Phys.	X		3	Sound	Mechanical vibrations; acoustical instruments; architectural and physiological acoustics
	Speech		X	3	Speech Science	Acoustic-phonetic analysis of speech
			X	3	Physiological and Psychological Acoustics	Theoretical concepts and supporting data of the process of hearing
			X	3	Advanced Anatomy, Physiology and Neurology of the Speech Mechanism	Acoustics of speech production included
			X	3	Advanced Anatomy, Physiology and Neurology of the Hearing Mechanism	Transmission of sound through the ear included
			X	3	Studies in Physiological and Psychological Acoustics	Research studies in psychoacoustics
			X	3	Seminar in Psychoacoustics	Individual research and reports in psychoacoustics
			X	3	Studies in Experimental Phonetics	Research studies in voice science including studies in acoustic phonetics
			X	3	Seminar in Phonetics and Speech Science	Individual research and reports that may include work in acoustic phonetics
Colo. School Mines	Phys.		X	3	Acoustics	
Colo. State Univ.	Hearing and Speech Sci.	X		3	Speech Science	The physiological, physical, and psychological characteristics of speech as related to the theory of speech production and interpretation of speech signals
			X	3	Hearing Science	Normal auditory processes, psychoacoustics, psychophysical methods, and psychological correlates of auditory stimuli
			X	3	Bio-Acoustic Instrumentation	The recording, reproduction, and analysis of human and animal voicing
			X	3	Environmental Audiology	Principles of noise analysis, noise control, and hearing conservation in communities, industry, and the military

Courses with Major Acoustics Content—Continued

INSTITUTION	DEPARTMENT	LEVEL Under-grad.	LEVEL Grad.	CREDIT HOURS	COURSE TITLE	DESCRIPTION WHERE PROVIDED AND PERTINENT
Colo. State Univ. (continued)	Phys.	X		3	Acoustics of Speech and Music	Nature and sources of sound including voice and musical instruments; physics of hearing and architectural acoustics
Colo. Univ. of	Arch. Eng.	X		2	Architectural Acoustics	For engineers and architecture students; related to room design and environmental noise
Columbia Univ.	Ocean Eng.		X	3	Applications of Ocean Acoustics	Acoustic oceanographic measurements; distortions of acoustic signals in space and time and their causes; acoustic transmitting and receiving systems; signal processing techniques
			X	3	Acoustic Propagation in the Ocean	The scalar wave equation and solutions; ray theory and ray tracing; convergence zones, ducted propagation
Conn., Univ. of	Phys.	X	X	3	Acoustics	
			X	3	Acoustics	
	Linguistics		X	6	Experimental Phonetics	Testing of phonological hypotheses; articulatory and auditory phonetics; acoustics and physiology of speech production; laboratory techniques
			X	3	Analysis and Synthesis of Speech	Linguistic theory with emphasis on sound pattern; physiology of speech production; theory of speech production; laryngeal excitation and vocal-tract configuration; analysis of speech
Cornell Univ.	Elec. Eng.	X	X	2	Bioelectric Systems	Sensory processing in nervous system, emphasis on auditory system
	Neurobiology and Behavior	X		4	Animal Communication	Sensory communication in animals, with emphasis on auditory signaling
	Psych.	X	X	4	Psychophysics and Scaling	Signal-detection theory in psychoacoustics
			X	4	Seminar: Mathematical Psychology	Topics in auditory processing models
		X	X	4	Sensory Function	Topics in physiological acoustics and other senses
Drexel Univ.	Elec. Eng.	X		3	Electro-Acoustics	Fundamentals of vibrating systems; equations of motion; acoustical electrical and mechanical analogs; properties of waves in fluids; design of transducers
			X	6	Electroacoustic Phenomena I, II, III	Sound generation and propagation in liquids and normal solids; electromechanical-energy conversion
Eastern Mich. Univ.	Phys.	X		3	Vibration and Sound	Intermediate level course for physics majors and minors
		X		2	Musical Acoustics	Special service course for music majors
E. Stroudsburg State Coll.	Phys.	X		3	Acoustics	Survey course; introductory
	Speech	X		3	Voice Science	Physiologic acoustics
Federal City Coll.	Speech and Hearing	X	X	3	Hearing Disorders—Tests and Measurements	Psychophysical parameters used to describe hearing and its variations; test procedures
		X	X	3	Anatomy and Physiology of Speech and Hearing	Anatomical structures are related to the acoustic events they produce or receive
			X	3,5	Experimental Phonetics	Laboratory and lecture on specialized equipment to mediate between physical events and the perceptual limitations
Federal Univ. of Rio de Janeiro	Linguistics		X	3	Acoustic Phonetics	Acoustic properties of speech sound and their articulatory correlates; techniques for acoustic analysis of speech
Fla., Atlantic Univ.	Ocean Eng.	X		3	Mechanical Vibrations	Mechanical vibrations; dynamic behavior of foundationlike structure and vibration isolation
		X		3	Acoustics	Wave equation, propagation in solids and fluids, speech, hearing, noise, architectural acoustics

Courses with Major Acoustics Content—Continued

INSTITUTION	DEPARTMENT	LEVEL Under-grad.	LEVEL Grad.	CREDIT HOURS	COURSE TITLE	DESCRIPTION WHERE PROVIDED AND PERTINENT
Fla., Atlantic Univ. (continued)		X		3	Transducer Design	Acoustic transducers, calibration, and analysis
		X		3	Underwater Sound Propagation	Propagation in the ocean; sonar equation, natural and man-made noise
		X		4	Communications Theory I	Fourier transform principles, electric networks; probability applications, noise components and circuits, information theory, applied to acoustic signal processing
		X		3	Communications Theory II	Detection of signals in noise, decision theory, optimum linear filters, modulation; sonar-signal processing
			X	3	Wave Theory	Fundamental concepts of vector field theory and wave theory with electromagnetic, mechanical, and acoustic applications
			X	3	Communication Theory	Theory of information processing communications and sonar
			X	3	Advanced Acoustics I	Directed readings and laboratory experiments in acoustic transducers, arrays, and beam forming
			X	3	Advanced Acoustics II	Directed reading and laboratory experiments
Fla. Presbyterian Coll.	Phys.	X		3	Acoustics	One-semester introductory course
		X		3	Sound	One-semester survey for nonscience majors
Fla. State Univ.	Audiology	X		2	Communication Science	Speech communication
			X	4	Electroacoustics	Speech wave analysis
			X	2	Psychoacoustics	
	Eng. Sci.		X	4	Mechanical Radiation	Study of elastic waves in isotropic and anisotropic materials
	Geology		X	3	Wave Propagation	Theory of linear waves in fluids and solids
	Psych.	X		3	Sensory Processes	Audition; vision, somesthesis, olfaction
			X	3	Physiology; Psychiatry II	Audition; physiology of receptor and sensory nerve
			X	3	Seminar in Auditory Processes	Purely audition, from psychophysics to cerebral physiology
Fla., Univ. of	Architect.	X	X	4	Architectural Acoustics	Fundamentals; nature of acoustical problems in buildings, how they are analyzed and solved
			X	4,4	Environmental Systems Design I	Applied problems in architectural acoustics
	Mech. Eng.		X	3	Vibrations	Vibrational systems, damping characteristics of materials
	Speech	X		5	Speech Acoustics	Introduction to human speech communication: methodologies, physics of sound, and elementary instrumentation
		X		5	Fundamentals of Hearing	Normal-hearing processes; anatomy, psychophysical methods, and subjective correlates of the auditor system
			X	5	Laboratory Instrumentation	Electroacoustical instruments in communication sciences research; electronic concepts for instrumental study of speech, hearing, and language
			X	5	Psychoacoustics	Advanced topics and current research in auditory sensation and perception
			X	3	Psychoacoustic Laboratory	Analysis of stimulus generation equipment; replication of classical experiments
			X	3	Seminar in Audition	Advanced research problems in psychoacoustics or acoustic physiology
Gallaudet Coll.			X	2	Acoustic Phonetics	Theory of speech production, analysis, synthesis, and aspects of experimental phonetics
Georgetown Univ.	Phys.	X		3	Acoustics	Oscillations, plane sound wave generation and measurement; audible and ultrasonic sound
			X	6	Ultrasonics and Physical Acoustics	Generation and detection of ultrasonic waves; mechanical waves in fluids and crystals; interaction of phonons with phonons and electrons

Courses with Major Acoustics Content—Continued

INSTITUTION	DEPARTMENT	LEVEL Undergrad.	LEVEL Grad.	CREDIT HOURS	COURSE TITLE	DESCRIPTION WHERE PROVIDED AND PERTINENT
George Washington Univ.	Eng. and Appl. Sci.		X	3	Introduction to Acoustics	Waves in infinite medium, transmission in layered media, analogies, resonators, horns and wave guides, physiological and architectural acoustics
			X	3	Advanced Theoretical Acoustics	Classical scattering and diffraction problems, acoustics of moving sources, propeller noise, ray tracing, boundary and jet noise
			X	3	Random Process Theory	Probability theory; random variables; correlation functions and power spectra; behavior of systems under random inputs
			X	3	Physical Acoustics	Waves, nonlinear acoustics, streaming, boundary layers, aerodynamic noise, atmospheric attenuation, thermal and viscous phenomena
			X	3	Psychological and Physiological Acoustics	The ear, experimental psychoacoustics, subjective responses to noise, displays, effects of noise and sonic boom on people
			X	3	Special Topics in Acoustics	Topics chosen from such areas as aerospace noise generation and control; instruments; responses of structures, people, and communities to noise
Guelph, Univ. of	Psych.	X		3	Perceptual Processes	Physiological and psychological concomitant of acoustics
Hartford, Univ. of	Mech. Eng.	X		3	Engineering Acoustics	
		X		3	Advanced Engineering Acoustics	
		X		3,9	Senior Research Topics in Acoustics	
		X		3	Vibrations I	
		X		3	Vibrations II	
		X		3	Musical Acoustics	
Hawaii, Univ. of	Solid Earth Geophys.	X		3	Seismology	Elastic properties of rocks, behavior of earthquake waves; instruments; seismograms
		X		3	Seismic Source Mechanisms	Study of source mechanisms for explosions and earthquakes
		X		3	Seismic Propagation Phenomena	Propagation of energy through solid media having interfaces
		X		3	Analysis and Synthesis of Seismograms	Development of theoretical seismograms for comparison with observed seismograms
		X		3	Seismometry and Seismological Model Study	Seismological instrumentation; application of models to interpretation of observations; selected topics
Hofstra Univ.	Phys.	X		3,3	Acoustics of Music and Speech	One-year course for music and speech majors
Houston, Univ. of	Elec. Eng.		X	3	Underwater Acoustics II	Underwater system signal design
			X	3	Underwater Acoustics III	Underwater system design
			X	3	Statistical Wave Propagation	Propagation
	Mech. Eng.	X		3	Mechanical Oscillations	Introductory vibrations and acoustics
		X		2	ME Lab—Vibrations and Acoustics	Instructional and project experiments in vibrations and acoustics
		X		3	Noise Control	Control of noise in design and engineering of machines, buildings, aircraft, ships, and autos; urban noise problems
		X		3	Vibration Analysis	Single- and multiple-degree-of-freedom systems; free and forced vibrations; approximate methods of analysis, matrix methods
			X	3	Analytical Methods in Vibrations	Normal modes of vibration of discrete and continuous systems; response to periodic and general excitation; variational principles
			X	3	Advanced Physical Acoustics	Topics in physical acoustics; nonlinear acoustics; cavitation; hypersonics

Courses with Major Acoustics Content—Continued

INSTITUTION	DEPARTMENT	LEVEL Under-grad.	LEVEL Grad.	CREDIT HOURS	COURSE TITLE	DESCRIPTION WHERE PROVIDED AND PERTINENT
Houston, Univ. of (continued)	Mech. Eng./ Elec. Eng.	X		3	Vibration-Acoustical Transducer	Principles of transduction, motional impedance, calibration and reciprocity, measurement of acoustic-vibration quantities
			X	3	Stress Waves in Continuous Media	Dynamics of continuous media, stress wave propagation in solids and liquids
			X	3	Mechanical Radiation	Wave equations and solution techniques
			X	3	Underwater Acoustics I	Underwater sound systems, signal processing, ray tracing, and directivity of transducers and arrays
			X	3	General Acoustics and Vibration	Vibration
Hunter Coll.	Communication Sci.	X		3	Speech Acoustics and Perception	Physical bases of speech; acoustical properties of speech; psychological acoustics; laboratory techniques
			X	3	Introduction to Speech and Hearing Sciences	Acoustical and perceptual variables in speech and hearing
			X	3	The Phonetics of American English	Phonetics and phonemic analysis of contemporary speech
			X	3	Speech Science	Acoustic phonetic analysis of production and perception of speech
			X	3	Experimental Phonetics	Experimental methods and literature used in research in voice and phonetics
			X	3	The Phonology of the Dialects of American English	Detailed examination of major American dialects
			X	3	Comparative Phonetics	Sound systems of selected languages compared with English
			X	3	Physiological and Psychological Acoustics	Concepts and supporting data on hearing processes
			X	3	Community and Industrial Programs in Audiology	Planning and organizing hearing conservation programs; mass hearing surveys
			X	3	Physiological Acoustics	Acoustical principles; applications to the physiology of the ears; central auditory pathways
	Psych.		X	3	Comparative Physiological Acoustics	Selected topics including structures along the auditory pathway
Ill., Univ. of	Aero. and Astro. Eng		X	3	Stochastic Structural Dynamics	Structural dynamics problems treated from probabilistic point of view
	Architect.	X		?	Environmental Control	Architectural acoustics and building noise control
	Elec. Eng.	X	X	3	Engineering Acoustics	General course in acoustics
		X	X	3	Ultrasonic Techniques	Fundamentals of ultrasound in fluid and solid media and comprehensive treatment of selected applications in industry and medicine
		X		3	Analysis of Musical Sounds	
	Music	X	X	2	Musical Acoustics I and II	Fundamentals of mathematics and physics; wave forms; vibrations; the ear; musical scales; musical instruments; architectural acoustics
	Speech	X	X	3	Speech 376	Basic acoustics; acoustics of speech
			X	4	Speech 476	Literature survey of acoustics, acoustics of speech; instrumental analysis and synthesis
	Theo. and Appl. Mech.	X	X	3	Acoustics	Basic introduction
Ind. Univ.	Anatomy and Physiology		X	2	Comparative Behavioral Physiology	
	Center for Neural Sci.		X	3	Neural Mechanisms of Hearing	Anatomy and physiology of auditory system; behavioral studies of auditory discrimination in man and lower animals
	Music		X	3	Experimental Phonetics for Singing	Speech as a servosystem; signal detection and intelligibility; characteristics of the voice

Courses with Major Acoustics Content—Continued

INSTITUTION	DEPARTMENT	LEVEL Under-grad.	LEVEL Grad.	CREDIT HOURS	COURSE TITLE	DESCRIPTION WHERE PROVIDED AND PERTINENT
Ind. Univ. (continued)			X	3	Acoustic Phonetics for Singing	Analysis of physical nature of speech sounds in song; use of sonograph, wave analyzers, and video tape
	Phys.	X		5	General Physics: Mechanics, Heat, and Sound	
	Psych.	X		3,2	Sensation and Perception	Theories and data in psychophysics and other studies of sensation and perception
		X	X	3	Hearing and Communication	Processes in communication by speech
				3	Psychophysics	Signal detection for various senses
			X	3	Psychophysiology of Hearing	Anatomy and physiology of auditory system
	Speech and Theatre	X		3	Introduction to Clinical Audiology	
		X		3	Clinical Audiology Testing	
			X	3	Clinical Audiology	
Inst. of Marine and Atmospheric Sciences	Ocean Eng.	X	X	3	Introduction to Underwater Acoustics	Vibration, harmonic analysis, propagation of sound, ray tracing, introduction to normal mode theory, ambient noise, transducers, and hydrophones
			X	3	Advanced Underwater Acoustics	Reflection and refraction, eikonal equation, wave and ray theory, normal modes, propagation in deep and shallow water
Instituto Politécnico National (Mexico)	Mech. Eng.	X		6	Acoustics	Resolution of acoustical circuits
Johns Hopkins Univ.	Biomedical Eng.		X	NA	Research Seminar on Physiology of Hearing and Speech	Review of literature with consideration of physiological and biophysical results from view of communication engineering
	Biophys.		X	3	Seminar in Sensory Communication	Speech communication, auditory neurophysiology
	Elec. Eng.		X	3	Signal Analysis and Representation	Statistical techniques for use with electronic and acoustic signals
	Phys.		X	3	Vibrations and Wave Motion	
Kans. State Univ.	Speech Path. and Audiology		X	3-5	Individual Investigation	Independent study of an area or problem in speech or hearing
			X	3	Industrial Audiology	Noise measurement, modification, and control
			X	3	Psychoacoustics	Psychological or behavioral response to acoustic stimuli
			X	3	Experimental Audiology	Historical and modern research in audition—survey
			X	3	Seminar in Audiology	Categories covered include acoustic physics
			X	3	Instrumentation	Study of instruments used in both acoustic and speech research
Kans., Univ. of	Speech		X	3	Physics of Sound	Basic concepts for majors in speech pathology
Laval Univ.	Architect.	X			Acoustics I	Basic acoustical terms and requirements of rooms; introductory level
		X			Acoustics II	Acoustic materials and design requirements for public buildings; control of noise and vibration
La. State Univ.	Physiology		X	3	Auditory Physiology	
			X	3	Advanced Auditory Physiology	
McGill Univ.	Architect.	X			Architectural Acoustics	Acoustics in architectural design; auditorium acoustics; sound systems; noise control
	Eng.	X			Mechanics of Continuous Media	Study of wave propagation in strings, membranes, bars, fluids
		X			Acoustics	Propagation, directivity, transducers, underwater acoustics, architectural acoustics, noise control

Courses with Major Acoustics Content—Continued

INSTITUTION	DEPARTMENT	LEVEL Under-grad.	LEVEL Grad.	CREDIT HOURS	COURSE TITLE	DESCRIPTION WHERE PROVIDED AND PERTINENT
Mass. Inst. Technol.	Aero. and Astro.		X	3	Aerodynamic Noise	Fundamentals of noise generated with the operation of aeronautical devices
	Arch. Eng.	X		3	Architectural Acoustics	Acoustics of buildings; field studies in noise control and hearing conditions
		X		3	Environmental Control—Acoustics	Acoustic design for good hearing conditions and control of noise in rooms and buildings; lab
			X	Arr	Special Problems in Architectural Acoustics	Functional acoustic design in architecture based on project work in actual buildings
			X	3	Special Problems in Acoustics	Development of skills in acoustic measuring and interpretation
	Earth and Planetary Sci.		X	3	Marine Acoustics	
	Elec. Eng.	X		3	Sound, Speech, and Hearing	Physical, physiological, and psychological bases of auditory communications; neural and muscular elements, auditory system
		X		3,1	Acoustics	Sound generation and propagation in elastic media; conversion between acoustical, electrical, and mechanical energy; noise and vibration control; interaction of sound and man
		X			Sensory Communication	Sensory performance from viewpoint of the communication sciences
			X	3	Signal Transmission in the Auditory System	
			X	3	Speech Communication	Linguistics and theory of speech production
			X		Sensory Neural Systems	
			X		Laboratory: the Physiology, Acoustics, and Perception of Speech	Computer analysis, spectrographic analysis, X-ray motion pictures, psychophysical testing
	Mech. Eng.	X		3	Vibrations	
			X	3	Wave Propagation	Wave concepts in applied mechanics; WKB and eikonal approximations, ray theory vs full-wave theory; nonlinear waves, generation of waves during impact
			X	3	Sound and Structural Vibration	Generation of sound; statistical theory of room acoustics; sound absorption and reverberation time; vibration of beams and plates
			X		Ultrasound and Its Biomedical Applications	
			X		Topics in Biomedical Engineering	Mainly basic ideas and concepts in ultrasonic neurosurgery
			X	3	Random Vibration	
			X	3	Flow Noise	
			X	3	Noise and Vibration in Transportation Systems	A survey of the state of the art in: aircraft noise; ground-transportation noise; urban-noise models; and power-plant noise
	Naval Arch. and Marine Eng.		X	3	Hydroacoustics	Underwater acoustics important to modern naval architecture and marine engineering
			X	3	Acoustics and Shock Response of Submerged Structures	Steady-state and transient interaction between vibrating elastic plates and shells and ambient water; sound radiation and scattering by plane and curved surfaces; farfield and short-wavelength solutions of the wave equation; acoustic transients; structural vibrations; coupled acoustical and vibrational problem
			X	3	Flow Noise	Lighthill's theory of aerodynamic sound; Curle's theory of the influence of solid boundaries; structural response and radiation
			X	3	Fundamentals of Underwater Sound Applications	Design of transmitters and receivers of underwater sound; analysis of present-day sonar systems; acoustic wave equations; transmitting and receiving arrays; sonar design principles; sounders, oceanographic sensors, defense systems, communications

Courses with Major Acoustics Content—Continued

INSTITUTION	DEPARTMENT	LEVEL Under-grad.	LEVEL Grad.	CREDIT HOURS	COURSE TITLE	DESCRIPTION WHERE PROVIDED AND PERTINENT
Mass. Inst. Technol. (continued)			X	3	Mechanical Vibration	
			X	3	Acoustics and Structural Vibration	Elements of sound radiation and vibrations of continuous elastic structures; analysis of shock response in structures; theory of scaled model tests
Mass., Univ. of	Elec. Eng.		X	3	Introduction to Speech Analysis	Theory and methods of speech analysis
			X	3	Advanced Speech Processing	Current developments in speech analysis, synthesis, recognition, perception
		X	X	3	Acoustics	Basic physics and acoustics theory
		X	X	3	Underwater Acoustics	Introduction to theory and practice of underwater acoustics
		X		1,3	Speech Communications Lab	Special lab projects for seniors
	Mech. and Aero-space Eng.		X	3	Stochastic Processes	General random signal theory; selected problems, examples, and demonstrations
			X	3	Theoretical Acoustics	Emphasis on engineering aspects of acoustics: engine noise, measurements
		X		2	Special Projects	Undergraduate experimental projects in acoustics and acoustic measurements
	Speech		X	3	Experimental Phonetics	Study and analysis of phonetic elements of language; instruments and methods of analysis
			X	3	Advanced Clinical Audiology	Theories, methods, and procedures for special diagnostic testing in audiology
			X	3	Trends in Contemporary Audiology	Recent research and advances in knowledge of auditory capacities
		X	X	3	Anatomy and Physiology of Speech and Hearing Mechanisms	Consideration of respiration, phonation, articulation, audition
		X	X	3	Hearing and Speech Science	Fundamental characteristics of acoustic stimuli in speech and hearing processes
Memphis State Univ.	Psych. and Speech and Hearing		X	3	Hearing Conservation	Physics of sound; noise measurement and analysis; anatomy and function of the ear; hearing conservation
Miami Univ.	Psych.	X		4	Sensory Psychology	Sensory psychophysiology; emphasis on hearing and vision
Mich. State Univ.	Audiology and Speech Sci.		X	4	Acoustic Phonetics	Analytic study of the acoustics of speech
Mich., Univ. of	Elec. Eng.	X		3	Electroacoustics and Ultrasonics	Electromechanical and electroacoustical systems; loudspeakers and microphones and acoustic measurements
	Eng.	X		3	Acoustics	Introductory
		X	X		Acoustic Signal Processing	
	Eng. Mech.		X	3	Wave Motion in Continuous Media	Wave propagation in elastic media; forced motion of elastic systems
	Mech. Eng.	X	X	3	Fundamentals of Modern Acoustics	Plane waves and acoustic fields of point sources; transmission and radiation phenomena; random processes, correlation and power spectral density relationships; similarity methods; concepts of noise and vibration control in mechanical system design
	Otolaryngology		X		Physiological Acoustics	
	Physiology		X	2	Physiology of Hearing	Acoustics of the middle ear
			X	2	Research Methods	Acoustic measurements in otohinolaryngology research

Courses with Major Acoustics Content—Continued

INSTITUTION	DEPARTMENT	LEVEL Under-grad.	LEVEL Grad.	CREDIT HOURS	COURSE TITLE	DESCRIPTION WHERE PROVIDED AND PERTINENT
Minn., Univ. of	Aerospace	X	X	3	Acoustic Wave Propagation	
		X	X	3	Architectural Acoustics	
		X	X	3	Jet Engine and Aircraft Noise	
	Elec. Eng.		X	3	Fundamentals of Acoustics	Vibrations; compressible fluids and acoustic equations, radiation, transmission; nonlinear acoustical phenomena; shock waves; acoustics of moving media
	Eng. and Mech.		X	3	Mechanical Wave Propagation	
	Geophys.		X	3,3	Theory of Elastic Wave Propagation	
	Speech Sci. Path. and Audiology	X		3	Fundamentals of Sound	Basic acoustics, emphasis on decibels and their manipulation
			X	3	Hearing Science	Psychoacoustics
			X	3	Noise and Man	Damage risk criteria; hearing conservation programs; ear protection
Miss., Univ. of	Phys.		X	6	Acoustics	Physical acoustics and relaxation processes
Montreal, Univ. of	Architect.	X			Acoustics	Acoustics, acoustic materials, and design requirements for public buildings; control of noise and vibration
Mo., Univ. of Kansas City	Speech and Hearing Sci.	X		3	Introduction to Audiology	Theory and principles of audiology
		X		3	Speech Science	Physical phenomena associated with hearing
		X		3	Physiology of Speech	Anatomy of the ear
Rolla	Phys.	X	X	3	Acoustics	Principles of wave motion and the science of sound, including the production, transmission, and effects of sound; application to principles in speech, music, radio, and architecture
Nev., Univ. of	Speech and Drama	X	X	3	Introduction to Audiometry	Anatomy of the ear; physics of sound; path of the ear; hearing conservation
			X	3	Clinical Audiology	Measurement of hearing and medical interpretation of result
			X	3	Instrumentation	Calibration of acoustic instruments; measurements of sound levels
N. H., Univ. of	Elec. Eng.	X	X	4	Introduction to Acoustics	General introduction to physical acoustics with emphasis on noise and architectural acoustics
		X	X	4	Underwater Acoustics	Introduction to problems of sound propagation in water
N. Y. Univ.	Meteorology and Oceanog.		X	3	Transmission of Sound in Seawater	Underwater acoustics; introduction to theory of sound transmission
N. C. State Univ.	Ind. Eng.	X		3	Human Factors; Equipment Design	
			X	3	Human Factors; Systems Design	
			X	3	Skilled Operator Performance	
			X	3	Biotechnology in Systems Engineering	
	Psych.		X	1	Noise Pollution	Seminar surveying the noise problem: industrial noise, damage risk criteria, airport noise, sonic booms
			X	3	Special Topic—Psychoacoustics	Seminar covering hearing, speech communications, analysis and synthesis of speech, perception and psychophysics
N. C., Univ. of	Psych.		X	3	Seminar: Contemporary Issues	Psychoacoustics seminar: review of relevant literature

Courses with Major Acoustics Content—Continued

INSTITUTION	DEPARTMENT	LEVEL Under-grad.	LEVEL Grad.	CREDIT HOURS	COURSE TITLE	DESCRIPTION WHERE PROVIDED AND PERTINENT
Northeastern Univ.	Elec. Eng.		X		Physical Acoustics	Radiation, transmission, and absorption of plane and spherical waves; distributed systems
			X		Speech Communications	Acoustic transducers; mechanism of speech production; analog synthesizers of speech
			X		Underwater Sound	Fundamentals of sonar and acoustic signal processing; echo ranging and direct listening; matched filters and correlation detection
N. Ill. Univ.	Speech Path. and Audiology	X		3[a]	Audition and Acoustics	Physical acoustics, the normal auditory process, and psychophysical processes relevant to audition
		X		3[a]	Introduction to Speech Science	Perceptual, physiological, and acoustical analysis of speech and the relation to phonetic theory
			X	3[a]	Speech Science	The acoustical, physiological, and psychological foundations of oral communication
			X	3[a]	Audition	Acoustics, psychophysical methods, and the measurement of the normal ear response
			X	3[a]	Acoustic Instrumentation	Theoretical and practical aspects of electronic audio-frequency lab equipment commonly used for evaluation and research in speech pathology
			X	3[a]	Experimental Phonetics	Research and lab methods used in analysis of speech and the speech mechanism
Northwestern Univ.	Civil Eng.	X	X		Dynamics of Structures	Analysis of systems with one and several degrees-of-freedom; non-linear force-displacement relation and damping; vibrations of flexural members
			X		Theory of Elasticity I, II	Wave motion in elastic media, stress and strain
			X		Soil Dynamics	Nuclear weapon effects, earthquake response, vibrations of machine foundations, wave propagation and attenuation, linear and non-linear systems
	Communicative Disorders	X	X		Introduction to Psychoacoustics	Pitch, loudness, differential sensitivity, distortion products, adaptation, fatigue, masking, binaural processes, and auditory theories
			X		Speech Science	Physiologic, neurologic, and acoustic study of speech monitoring, control, and perception
			X		Community and Industrial Programs in Audiology	Screening tests; pure-tone audiometry; community services in audiology; measurement, evaluation, and control of industrial noise; acoustic trauma
			X		Topics in Physiological Acoustics	Advanced experimental techniques; inner-ear mechanics, neural coding, and feedback mechanism in the auditory system
	Elec. Eng.	X	X		Engineering Acoustics	Mechanical vibrating systems and electrical analogs with application to loudspeakers and microphones; large-area and underwater acoustics
	Eng. Sci.		X		Wave Propagation	Wave equation in one, two, and three dimensions; Helmholtz equation; guided and unguided propagation of electromagnetic waves; radiation from structures; surface waves
			X		Theory of Diffraction	Transmission and reflection of waves; diffraction by cylinders, spheres and obstacles of arbitrary shapes
			X		Geophysical Fluid Dynamics I, II	Basic equations; steady motions; stratification of the atmosphere, oceans, and lakes; waves in simple models; theory of rays
	Linguistics		X		Descriptive Analysis I: Phonetics	Principles of articulatory phonetics, acoustic phonetics, and phonetic transcription
			X		Introduction to Instrumental Phonetics	Techniques of instrumental phonetics, articulatory and acoustic

[a] Semesters

Courses with Major Acoustics Content—Continued

INSTITUTION	DEPARTMENT	LEVEL Under-grad.	LEVEL Grad.	CREDIT HOURS	COURSE TITLE	DESCRIPTION WHERE PROVIDED AND PERTINENT
Northwestern Univ. (continued)			X		Acoustic Phonetics	Study of the acoustic aspect and spectrographic characteristics of speech
	Math.		X		Differential Equations of Mathematical Physics	Green's function, theory of distributions, integral equations, spectral theory, wave equation
	Mech. Eng.	X	X		Mechanical Vibrations	Vibrations in single- and multiple-degrees-of-freedom systems; free and forced vibrations with various types of damping; vibration measurement and control systems
			X		Nonlinear Vibration	Analytical methods of solution of problems of mechanical vibration; free damped and undamped vibration; elliptic functions; phase plane singular points; flutter
			X		Vibration of Continua	Vibration of strings, membranes, plates, spheres, beams, and rods; selected topics
			X		Advanced Mechanical Vibrations	Fundamental theories of vibration and machine dynamics and their application to engineering problems
			X		Dynamics of Shells	Fundamental dynamical equations of shell theory, vibration of cylindrical shells; shallow shells; variational principles and approximate methods
Notre Dame, Univ. of	Aero./Mech.	X	X	3	Linear Vibrations	Classical mechanical vibrations with acoustical examples
			X	3	Dynamics of Elastic Systems	Vibration and wave propagation
	Architect.	X		?	Environmental Control	Architectural acoustics and building noise control
Ohio State Univ.	Preventive Medicine		X		Aviation Medicine	Approx. 4 hours bioacoustics
Ohio Univ.	Hearing and Speech	X		4	Speech Science	An acoustical description of speech production and perception
		X		4	Speech Science Lab Methods	Practical application of material learned in speech science
			X	3	Experimental Phonetics I	Advanced courses in acoustics related to speech production and perception
			X	3	Experimental Phonetics II	
			X	3	Experimental Phonetics III	
	Phys.	X	X	3	Acoustics	Introduction to vibrations and waves
			X	4	Advanced Acoustics	Physical acoustics
			X	2	Theoretical Acoustics	Acoustic fields
			X	1	Research Seminar	Acoustic research
Okla. State Univ.	Architect.	X		3	Environmental Control in Buildings	Transmission, absorption, reverberation time, room shaping, noise control
	Mech. Eng.	X		3	Vibrations	Lumped parameter, distributed parameter
			X	3	Engineering Acoustics	Wave travel, mechanical radiation, noise measurement and control
	Phys.		X	3	Selected Topics in Acoustics	Selected topics in acoustics; radiation, transmission, and absorption of acoustic waves; high-intensity effects; ultrasonics
			X	3	Special Problems in Acoustics	Advanced problems in acoustics and ultrasonics
Okla. Univ. Med. Center	Communication Disorders		X	2	Voice Science Laboratory	Laboratory experience in techniques for speech analysis
			X	2	Advanced Voice Science	Review of literature on speech analysis, synthesis, and perception
Ore., Univ. of	Med. Sch.		X	5	Physiological Acoustics	Survey of current work at all levels of the auditory system

Courses with Major Acoustics Content—Continued

INSTITUTION	DEPARTMENT	LEVEL Under-grad.	LEVEL Grad.	CREDIT HOURS	COURSE TITLE	DESCRIPTION WHERE PROVIDED AND PERTINENT
Penn. Mil. Coll.	Eng. Mech.	X		3	Mechanical Vibrations	
			X	3	Vibrations	
Penn. State Univ.	Aero. Eng.	X		3	Flow Induced Noise	Special supervised study on theory and experiments on flow-induced noise
	Architect. Eng.	X	X	3	Building Acoustics	Noise control in buildings; ventilating system noise; acoustic design variables
		X		2–12	Research and Problems	Investigation, analysis, and preparation of comprehensive report on architectural acoustics
		X		3	Advanced Architectural Acoustics and Noise Control	Noise control in buildings; ventilating system noise and vibration
		X		2	Introductory Architectural Acoustics and Noise Control	Simple physics of sound and hearing; criterion for occupancy and privacy in buildings
	Continuing Education	X		0	Underwater Acoustics	One-week seminar
		X		0	Vibration and Vibration Damping	One-week seminar
	Elec. Eng.		X	3	Statistical Theory of Communications	Application of correlation and convolution to the detection of signals and noise
	Eng. Acoust.		X	1–6	Special Problems in Acoustics	Supervised study of any selected acoustics problem
			X	1	Seminar	Recent developments and current research in acoustics
			X	4	Underwater Sound Propagation	Propagation of sound in ocean; includes reflection and scattering
			X	4	Sonar Engineering	Problems in underwater detection and tracking
			X	4	Modern Acoustic Signal Processing	Signals, noise, filtering, ambiguity functions, linear and nonlinear signal processing
			X	4	Electroacoustic Transducers	Transducer theory, design, and calibration
			X	3	Acoustics in Fluid Media	Acoustic radiation and scattering, standing waves in ducts and cavities, propagation in moving fluids
	Eng. Mech.		X	3	Theory of Vibrations	Mathematical theory of vibrating strings, beams, membranes, and plates
			X	3	Vibration and Shock in Damped Mechanical Systems	Vibrational properties of various materials as a function of stiffness, damping, and mode of excitation; transients; shock spectra; damage; nonlinear response
			X	3	Stress Waves in Solids	Stress waves in elastic and plastic media
			X	3	Experimental Methods in Vibrations	Vibrational properties of materials; nondestructive testing
		X		3	Random Vibrations	Probability theory applied to random vibrations of linear and nonlinear systems; excitation of turbulence and noise; acoustic damping
	Geophys.		X	3	Seismology	Transmission of seismic waves
	Mech. Eng.	X		3–12	Noise Control in Machines	Special problems in the attenuation of machinery noise; laboratory
	Phys.	X		3	Intermediate Acoustics	Vibrations and simple vibrating systems
			X	3	Theoretical Acoustics	Complex vibrating systems; transmission through elastic and viscoelastic media with discontinuities
	Speech	X	X	3	Anatomy and Physics of the Ear and Vocal Mechanisms	Structure and function of the ear and vocal mechanism; pathologies affecting language processes
		X		4	Seminar in Speech Science	Physical and physiological bases of speech and voice; introduction to laboratory techniques
	Speech Path. and Audiology	X		3	Pure-Tone Audiometry	Techniques and interpretation of pure-tone audiometer measurements

Courses with Major Acoustics Content—Continued

INSTITUTION	DEPARTMENT	LEVEL Under-grad.	LEVEL Grad.	CREDIT HOURS	COURSE TITLE	DESCRIPTION WHERE PROVIDED AND PERTINENT
Penn. State Univ. (continued)			X	3	Speech, Audiometry, and Hearing Aids	Techniques and interpretation of speech reception tests; hearing aids and advisement procedures
			X	3	Acoustic Instruments for Hearing	Acoustical instruments for research in hearing and noise control
		X		3	Noise and Hearing	Criteria for noise damage to hearing; legal requirements and hearing protection
		X		3	Introduction to Audiology	Physics, physiology, psychology of hearing
Penn., Univ of	Biomed. Eng. Program, Elec. Eng. Dept.		X	3	Ultrasonics	Wave equation for ideal solids and viscoelastic materials; transducers; biomedical applications; cavitation; absorption mechanisms in fluids; velocity and absorption measurement in fluids
	Elec. Eng.		X	2	Ultrasonics	Wave propagation piezoelectric solids; transducers and equivalent circuits; velocity and absorption measurement; propagation in semiconducting materials; ultrasonic amplifiers
	Linguistics	X	X	2	Acoustic Phonetics	Description of speech signals; acoustic features and vocal tract configurations and movements; linguistic significance versus redundancy in signals
			X	2	Production and Perception of Speech	Phonetic transcription and experimental determination of accuracy; physiologically versus linguistically determined thresholds in speech perception
			X	2	Seminar in Acoustic Phonetics	Seminar in special topics
Pitt., Univ. of	Bioacoustics		X	5	The Application of Biophysical Principles to the Study of Audition	Physics of sound, computer processing of electrophysiological data
			X	4	Electrophysiology of the Auditory System	Transduction of acoustic energy into nerve impulses, neural coding of acoustic variables
			X	2	Psychoacoustics	Study of behavioral research in audition
			X	3	Selected Topics in Psychoacoustics	Study in depth of specific psychoacoustic topics
			X	varies	Independent Study in Bioacoustics	Independent pursuit of selected topics in Bioacoustics
			X	1	Seminar in Bioacoustics	Presentation and discussion of current research findings in Bioacoustics by staff and guest speakers
			X	varies	Research and Dissertation for the PhD Degree	Dissertation work in Bioacoustics
Polytechnic Inst. Brooklyn	Phys.	X		15	General Physics	Introductory; units
Princeton Univ.	Architect.	X		10	Architectural Acoustics	
			X	10	Architectural Acoustics	
	Psych.		X	3	Hearing	General area of hearing and acoustics according to needs of student
Purdue Univ.	Audiology and Speech Sci.		X	3	Experimental Audiology: Psychoacoustics	Analysis audiological tests; design of audiological research; noise control, and industrial audiology
	Elec. Eng.		X	3	Fundamentals and Applications of Acoustics	Electromechanical circuit analysis, traveling-wave systems; sound-radiating systems and transducers; sound sensation and the hearing mechanism
	Mech. Eng.		X	3	Engineering Acoustics	Wave equation, Fourier analysis, sound transmission, response of systems to shocks, propagation in ducts

Courses with Major Acoustics Content—Continued

INSTITUTION	DEPARTMENT	LEVEL Under-grad.	LEVEL Grad.	CREDIT HOURS	COURSE TITLE	DESCRIPTION WHERE PROVIDED AND PERTINENT
Purdue Univ. (continued)			X	3	Advanced Engineering Acoustics	Radiation of sound from structures, response of structures to pressure fluctuations, sound transmission using statistical energy analysis, experiments
		X		3	Noise Pollution and Its Control	Introduction to engineering acoustics, the ear, environmental acoustics, instrumentation, sonics, and noise-control techniques
Rensselaer Polytechnic Inst.	Geology	X	X	3	Oceanography	Includes acoustic radiation
	Math.		X	3	Mathematics Elective	Theory of sound transmission with application to the ocean
Rhode Island Univ.	Elec. Eng.		X	3	Electroacoustical Engineering I	Design of electroacoustic transmission channels and psychoacoustic aspects of use for high-quality music
			X	3	Electroacoustical Engineering II	Storage of sound, studio-design and acoustical measurements
	Ocean Eng.		X	3	Underwater Acoustics I	Underwater sound propagation, reflection; vibration of strings, membranes, transducers
			X	3	Underwater Acoustics II	
			X	3	Underwater Acoustics Propagation	Vibratory systems, propagation, ray theory, normal modes
			X	3	Bioacoustics	
Rochester Inst. of Technol.	Mech. Eng.	X		5	Mechanical Vibrations	Vibration of systems with several degrees of freedom, vibration of elastic bodies, vibrations-measuring instruments
Rose Polytechnic Inst.	Phys.	X		4	Acoustics	
Rutgers Univ.	Mech. Eng.		X	3	Acoustics	Propagation in fluid media; application to noise problems, sonic boom, and combustion instability
			X	3	Aerodynamic Noise	Introduction to modern theories of aerodynamic sound with applications to jet noise, propeller noise, and sonic boom
St. Edward's Univ.	Phys.	X		4	Wave Motion, Light and Sound	Introductory course; general wave motion and sound
San Diego State Coll.	Phys.	X		3	Acoustics	Wave motion; transmission, attenuation; introduction to speech and hearing, underwater sound, architectural acoustics
		X		2	Acoustics Laboratory	Laboratory in velocity of sound, acoustic impedances, calibration of microphones and loudspeakers, reciprocity measurements, architectural acoustics, and radiation
		X		2	Applied Acoustics	Propagation in various media; underwater acoustics; transducers; sonar equation; analysis of signals and noise
			X	2	Advanced Acoustics	Wave equations; attenuation; propagation in bounded and unbounded media; radiation and scattering
		X		3	Senior Thesis	Individual student investigation and report on problems in acoustics for seniors
			X	3–6	Research and Thesis for Master's Degree	Master's investigation and thesis; emphasis in acoustics
	Speech Path. and Audiology	X		3	Audiometry	Includes physics of sound and the decibel
San Fernando Valley State Coll.	Phys.	X		3	Sonics	Simple vibrating systems, propagation of sound in fluids, elements of underwater acoustics
Scranton, Univ. of	Phys.	X		3	Acoustics	Basic course

Courses with Major Acoustics Content—Continued

INSTITUTION	DEPARTMENT	LEVEL Under-grad.	LEVEL Grad.	CREDIT HOURS	COURSE TITLE	DESCRIPTION WHERE PROVIDED AND PERTINENT
Southampton, Univ. of	Eng. Sci.	X		6	Human Factors in Engineering	
		X		6	Acoustics and Vibration	
	Inst. of Sound and Vibration Research		X	2	Fundamentals of Acoustics	
			X	2	Random Process Analysis	
			X	2	Fundamentals of Vibration	
			X	2	Turbulence and Aerodynamic Noise I	
			X	2	Turbulence and Aerodynamic Noise II	
			X	2	Sound Transmission	
			X	2	Noise Control	
			X	2	Theory of Acoustics	
			X	2	Physical Acoustics	
			X	2	Subjective Effects of Noise	
			X	2	Vibration of Aircraft Structures	
			X	2	Building Acoustics	
			X	2	Auditoria Acoustics	
			X	2	Sociological Aspects of Noise	
			X	2	Structural Vibration I	
			X	2	Structural Vibration II	
			X	2	Materials Engineering	
			X	2	Random Vibration	
			X	2	Machine Vibration and Noise	
			X	2	Vibration Control	
			X	2	Nonlinear and Self-Excited Vibration	
			X	2	Shock and Packaging	
S. C., Univ. of	Eng.	X	X	3	Vibrations	Mechanical vibrations of discrete and continuous systems
Southern Calif., Univ. of	Architect.	X		?	Environmental Control	Architectural acoustics and building noise control
	Mech. Eng.		X	3	Engineering Acoustics	
			X	3	Underwater Acoustics	
	Phys.	X		2	Elementary Acoustics	Very elementary course for music students
Southern Miss., Univ. of	Speech and Hearing	X	X	4	Acoustic Phonetics	Basic acoustics and the acoustical theories of speech production and means of measuring acoustical properties
			X	4	Seminar: Laboratory Procedures	Laboratory; signal production and analysis with analog and digital techniques
State Univ. N. Y., Binghampton	Psych.	X		4,2	Perception	General survey of perception; special emphasis on auditory psychophysics
Buffalo	FEAS		X	3	Mechanical Wave Propagation I	Wave motions, in mathematical terms related to the wave equation and in specifics, i.e., acoustic, elastic, and gravity waves
	Psych.	X		3	Sensation and Perception	Introduction to phenomena of sensation and perception, and methods by which they may be studied
		X		5	Biological Bases of Behavior	Includes psychophysiology of hearing
			X	3	Discriminal Processes	Psychophysiology of the senses
	Speech Path. and Audiology		X	3	Speech Perception	Introduction to research and theories in the fields of speech perception and signal detection

Courses with Major Acoustics Content—Continued

INSTITUTION	DEPARTMENT	LEVEL Under-grad.	LEVEL Grad.	CREDIT HOURS	COURSE TITLE	DESCRIPTION WHERE PROVIDED AND PERTINENT
State Univ. N. Y., Buffalo (continued)		X		3	Hearing Problems and Testing	Study of problems of hearing, and diagnosis of such problems
		X		3	Auditory Training and Speech Reading	Auditory habilitation
		X		3	Residual Hearing and Hearing Aids	Hearing habilitation with emphasis on speech audiometry and hearing-aid evaluation
			X	3	Advanced Clinical Audiometry	Theory and application of tests and testing equipment
			X	3	Advanced Clinical Practicum in Speech Correction and Audiometry	Experiment with clinical cases
			X	3	Hearing Problems and Testing	Intensive study of problems associated with hearing loss
			X	3	Seminar: Hearing Disorders	Study of aspects of hearing loss—emphasis on research
Stevens Inst. Technol.	Ocean Eng.		X	2½	Acoustics	Fundamentals of vibration, plane and spherical waves, sources, receivers, resonators, ultrasonics, absorption, speech, hearing, noise, and architectural acoustics
			X	2½	Acoustics Laboratory	Experiments illustrating principles, practices, instrumentation for acoustics; sources, receivers, room acoustics, and underwater acoustics
			X	2½	Acoustic Signal Processing	Application of signal processing techniques to acoustic signals; Fourier transform, convolution and correlation integrals, optimum filters, additive and steered arrays
			X	2½	Transducers	Stress-strain relations of piezoelectric, electrostrictive and magnetostrictive transducers
			X	2½	Underwater Acoustics I	Fundamental equations governing sound propagation; acoustic properties of seawater; principles of active and passive sonar systems; noise in ocean environment; control of sound from surface and submerged vessels
			X	2½	Underwater Acoustics II	Advanced underwater acoustics; selected topics of current interest such as normal mode theory
Syracuse Univ.	Mech. Eng./ Aerospace		X	3	Independent Study	Aerodynamic noise study under guidance
			X	3	Gas Dynamics	Aerodynamic noise
	Linguistics		X	3	Acoustical Techniques in Phonetics	Experimental techniques for the analysis of the acoustical parameters of speech
			X	3	Physiological Techniques in Phonetics	Experimental techniques for the measurement and analysis of the physiological parameters of speech
			X	3	Mathematical Analysis of Speech	Relationship between the acoustic parameters and the parameters of the speech mechanism; speech synthesis and analysis
	Sensory Communication		X	3	Anatomy of Sensory Systems	Descriptive anatomy of the auditory, visual, cutaneous, olfactory, gustatory, and vestibular systems
			X	3	Sensory Physiology of Mammals	Functional organization of mammalian sensory systems; emphasis on the auditory system
			X	3	Measurement of Sensory Characteristics	Experimental methods used to obtain the operating characteristics of sensory systems
			X	3	Analysis of Sensory Systems	Sensory characteristics in terms of physiological processes
Temple Univ.	Speech		X	3	Seminar: Acoustic Phonetics	Examination of literature dealing with the acoustics of speech production
Tenn., Univ. of	Audiology and Speech Path.	X		3	Bases of Speech	Includes acoustics of speech
		X	X	3	Voice Science	Anatomy, physiology, and acoustics

Courses with Major Acoustics Content—Continued

INSTITUTION	DEPARTMENT	LEVEL Under-grad.	LEVEL Grad.	CREDIT HOURS	COURSE TITLE	DESCRIPTION WHERE PROVIDED AND PERTINENT
Tenn., Univ. of (continued)			X	3	Experimental Study of Speech	Experimental phonetics, instrumentation
			X	3	Experimental Study of Hearing	Psychoacoustics, instrumentation
		X		3	Laboratory Methods in Speech and Hearing	Equipment used in the analysis of speech and hearing
			X	3	Physiological Acoustics	Techniques in measuring cochlear potential and a survey of the research literature
			X	3	Military and Industrial Audiology	Acoustic analysis equipment; sound level meters, microphones, level recorders, filters; survey of literature on noise studies
	Phys.	X	X	4	Physical Acoustics	Considerations fundamental to detailed investigation of any branch of acoustics
			X	1	Ultrasonic Seminar	
			X	3	Advanced Topics in Classical Theory	Advanced topics of current interest are discussed in detail
			X	3	Advanced Topics in Quantum Theory Physics	
Tex., Univ. of	Architect.	X		3	Acoustics of the Environment	Architectural and engineering acoustics as it relates to man's environment
		X		2	Architectural Acoustics	Introduction to room acoustics and noise control; related to architectural design and construction
	Elec. Eng.	X	X		Introduction to Engineering Acoustics	
		X	X		Traveling Wave Engineering	
			X		Electromechanical Transducers	
			X		Underwater Sound Engineering	
			X		Waves in Layered Media	
			X		Nonlinear Acoustics	
	Mech. Eng.		X		Vibrations and Sound	
			X		Acoustics Field Theory	
			X		Ocean Sound Propagation	
			X		Underwater Signaling	
		X	X		Noise and Vibration Control	
		X			Introduction to Engineering Acoustics	
	Phys.		X		Vibration and Sound	
			X		Acoustic Signal Processing	
		X		4	General Technical Physics	General survey course
		X		4	General College Physics	General survey course
	Psych.	X	X		Psychophysics	
			X		Physiological Psychology	
			X		Audition	Psychophysics of hearing; emphasis on signal detection theory, relevant math and electrical theory
	Speech Path. and Audiology	X	X		Introduction to Speech Pathology and Audiology	
		X	X		The Vocal Mechanism and the Ear	
		X		3	Techniques and Interpretation of Hearing Tests	
		X		3	Clinical Audiology	
		X		3	English Phonetics and American Dialects	

Courses with Major Acoustics Content—Continued

INSTITUTION	DEPARTMENT	LEVEL Under-grad.	LEVEL Grad.	CREDIT HOURS	COURSE TITLE	DESCRIPTION WHERE PROVIDED AND PERTINENT
Tex., Univ. of (continued)		X		3	Elements of Physical Phonetics	
		X		3	Speech Perception	
			X	3	Research in Speech: Audiology	
			X	3	Advanced Audiology	
			X	3	Pediatric Audiology	
Toronto, Univ. of	Inst. Aerospace Studies			50[b]	Theory of Sound	
				50[b]	Aeroacoustics	Fundamentals of flow noise, jet noise, fan noise, boundary-layer noise, sonic boom
Tulane Univ.	Architect.	X		3	Acoustics	Introduction to architectural acoustics; basic sound theory, absorption, isolation, speech, mechanical system noise and vibration, and room acoustics
			X	3	Seminar in Architectural Science	Architectural design covering illumination, acoustics, water systems, and indoor climate control
Union Coll.	General Education	X		6	Population and Noise Pollution	Investigation of relationship between increasing population and environmental noise
		X		3	Sound and Music	Physics of sound and musical instruments; the ear and its relationship to the musical scale
	Mech. Eng.	X		3	Mechanical Engineering Project	Student-selected acoustic project
			X	3	Mechanical Vibrations	Introductory and intermediate topics in theory and applications of mechanical vibrations in engineering problems
			X	3	Mechanical Vibrations	Vibration theory in discrete mass systems and continua
	Special Program		X	0	Short Course: Modern Methods of Industrial and Product Noise Control	Background in theory, measurement, and economics of noise reduction
U. S. Naval Acad.	Phys.	X		4	Acoustics	Theoretical and experimental acoustics
		X		3	Underwater Acoustics and Sonar	Applied course for professional preparation
U. S. Naval Postgrad. School	Elec. Eng.	X		3,2	Sonar Systems	Sonar theory for active and passive systems; problems and limitations of operating a sonar system; modern systems are included
			X	3,2	Sonar Systems Engineering	Theory and engineering practices pertaining to passive and active sonar systems
			X	4,2	Underwater Acoustic Systems Engineering	Principles of underwater acoustics communications, surveillance, and navigation systems
			X	3,1	Signal Processing	Statistical decision theory to the detection of signals in noise; ambiguity diagrams for signal detection and parameter estimation
	Mech. Eng.	X		3,2	Mechanical Vibrations	Kinematics and kinetics of free and forced vibration of linear systems having one to two degrees-of-freedom
		X		4,0	Mechanical Vibrations and Noise Control	Vibrating systems of multiple degrees-of-freedom, free and forced vibrations, naval applications of noise control, vibration isolation, damping materials
			X	3,1	Advanced Vibrations	Matrix analysis of mechanical systems with many degrees-of-freedom
	Oceanography	X		3,0	Sound in the Ocean	A brief introduction to physics of underwater acoustics followed by detailed discussion of oceanographic factors affecting sound transmission
			X	3,0	Sound in the Ocean	Physics of underwater acoustics followed by a detailed discussion of the oceanographic factors affecting sound transmission in the ocean

[b] Lecture hours.

Courses with Major Acoustics Content—Continued

INSTITUTION	DEPARTMENT	LEVEL Under-grad.	LEVEL Grad.	CREDIT HOURS	COURSE TITLE	DESCRIPTION WHERE PROVIDED AND PERTINENT
U. S. Naval Post-gr. d. School (continued)	Phys.	X		4,2	Underwater Acoustics	Survey of acoustics with an emphasis on sound propagation in the ocean; basic equation for sonar, transducers for underwater sound; laboratory experiments on underwater acoustics, spectrum analysis, and transducers
		X		4,1	Fundamental Acoustics	Mechanics of free, forced, and damped simple vibratory systems
		X		4,2	Underwater Acoustics	Sound absorption and dispersion for classical and relaxing fluids; transmission of sound in the ocean; the eikonal equation and necessary conditions for ray acoustics; ambient noise; target strength; the sonar equations for active and passive systems; laboratory experiments
		X		4,0	Explosive Shock Waves	Explosive shock waves in air and water including Rankine–Hugoniot equations, experimental data; blast loads on structures; damage mechanism and principles of protection against damage
		X		3,2	Special Topics in Underwater Acoustics	A terminal course: topics may include additional material in underwater acoustics, transducers, nonlinear phenomena in acoustics, noise and vibration control; laboratory experiments
			X	4,0	Propagation of Waves in Fluids	Advanced treatment of special topics related to sound propagation in the ocean
			X	3,3	Transducer Theory and Design	A theoretical treatment of the fundamental phenomena basic to the design of piezoelectric and magnetostrictive transducer elements and arrays
			X	0,3	Advanced Acoustics Lab	Advanced laboratory projects in acoustics
			X	0,3	Seminar in Applications of Underwater Sound	A study of current literature on applications of acoustics to problems of naval interest
Universidad Nacional Autónoma de México	Architect.	X		6	Installations	Materials and their uses for enclosures
	Science	X			Physics	Theory of acoustics
Univ. of the Pacific	Speech and Hearing Sci.	X		4	The Auditory Process	To acquaint students with the basic information in physical and psychoacoustics
Utah, Univ. of	Architect.	X		1	Controlled Environment	Architectural acoustics and noise control
	Elec. Eng.		X	3,3	Electroacoustics	Acoustic waves and their transmission characteristics; microphones, loudspeakers; architectural acoustics
Vanderbilt Univ.	Hearing and Speech Sci.		X	3	Testing of Hearing	Theory and practice of hearing measurements with emphasis on basic pure-tone audiometric techniques; causative factors in hearing loss; evaluation of audiometric results
			X	3	Anatomy and Physiology of Speech	Structure and function of the neuromuscular system; fundamental physiological principles of speech production
			X	2	Anatomy and Physiology of Hearing	Structure, function, and pathology of hearing; psychoacoustic theories
			X	3	Experimental Phonetics	Research methods, instrumentation, and findings in the field of experimental phonetics
			X	3	Psychoacoustic Instrumentation in Audiology and Speech	Laboratory procedures in the design and conduct of research in audiology and speech science
			X	3	The Selection and Use of Hearing Aids	Clinical selection of hearing aids; principles of speech audiometry in assessing the usefulness of residual hearing
			X	3	Seminar in Audiology	Review of significant literature in the field of audiology

Courses with Major Acoustics Content—Continued

INSTITUTION	DEPARTMENT	LEVEL Under-grad.	LEVEL Grad.	CREDIT HOURS	COURSE TITLE	DESCRIPTION WHERE PROVIDED AND PERTINENT
Vanderbilt Univ. (continued)			X	3	Advanced Clinical Audiology	Special tests and exploratory techniques in audiologic assessment
			X	3	Seminar: Military and Industrial Audiology	Hearing conservation principles in the armed forces and in industry
Vermont, Univ. of	Phys.		X	1–3	Special Topics in Acoustics	Various topics in physical acoustics
			X	3	Biological Physics	Waves of various kinds in biology
	Physiology and Biophysics		X	3	Special Sense Receptors	Emphasis on the ear
	Psych.		X	3	Sensory Processes: Audition	
		X	X	3	Physiological Processes: Audition	Physiological and psychological acoustics
	Speech		X	6	Rehabilitative Radiology	
Victoria, Univ. of	Phys.		X	2	Acoustics	General and fundamental acoustics
	Psych.	X		3	Perception	The experimental study of visual and auditory perception
			X	1½	Sensory Psychology	Physiology of sensory organs and basic sensory processes
			X	1½	Perception	Higher order perceptual processes, both visual and auditory
Wash. State Univ.	Architect.	X		3	Architectural Acoustics and Lighting	Fundamentals of architectural acoustics; noise control; lighting for architecture
Wash., Univ. of	Aero. and Astro.		X	3	Wave Propagation in Fluids and Solids	Time-dependent fluid-flow problems; wave and shock propagation in gases and solids
	Architect.	X		2	Acoustics Seminar	Principles of acoustic designing as applied to buildings
	Biology and Elec. Eng.	X		3	Wave Effects in Biomaterials	Use of ultrasonic, electromagnetic, and light waves for diagnostic, therapeutic, and surgical uses
	Civil Eng.		X	3	Wave Propagation in Solids	Dynamic formulation of the theory of elasticity; elastic waves in two- and three-dimensional solids
		X		3	Introduction to the Mechanics of Continuous Media	Rigorous development of basic equation of motion of elastic solids and Newtonian fluids
	Elec. Eng	X		4	Electroacoustics	Fundamentals of acoustics and the electroacoustical aspects of electromechanical systems
			X	4	Electroacoustics	Vibration of strings, bars, and membranes; acoustical wave equation and solutions; electric, acoustic, and mechanical analogs
	Mech. Eng.	X		3	Mechanical Vibrations	Application of linear systems techniques to mechanical vibration problems; applications in vibration isolation, and instrumentation
			X	3	Analytic Methods in Vibration	Analysis of vibration phenomena in multidegree-of-freedom and continuous systems
			X	3	Nonlinear Mechanical Vibrations	Nonlinear damping and restoring forces; applications of the phase-plane delta and the Ritz averaging method
			X	3	Random Mechanical Vibrations	Measuring random vibrations, in designing simulation equipment, and in mechanical design for random vibration in aircraft and missiles
			X	3	Impulsive Loading and Wave Propagation	Analysis of impulsive loading and wave propagation in solids, liquids, and gases
	Mech. Eng. and Elec. Eng.		X	3	Acoustics in Engineering I	Acoustic wave transmission, reflection, refraction, and diffraction in solids, liquids, and gases
			X	3	Acoustics in Engineering II	Scattering of sound, diffraction, room acoustics, sound propagation in fluids with flow
	Mech. Eng. and Civil Eng.		X	4	Acoustics of Environmental Noise	
	Oceanography	X		2	Fundamentals of Underwater Acoustics	Fundamentals of vibration; strings, bars, and membranes; plane and spherical acoustic waves

Courses with Major Acoustics Content— Continued

INSTITUTION	DEPARTMENT	LEVEL Under-grad.	LEVEL Grad.	CREDIT HOURS	COURSE TITLE	DESCRIPTION WHERE PROVIDED AND PERTINENT
Wash., Univ. of (continued)		X		2	Applications of Underwater Acoustics	Transducers and arrays, passive and active tracking, acoustic telemetering
		X		2	Acoustic Seismic Techniques	Acoustic data-taking techniques; analysis of acoustic bathymetry and seismic data
	Psych.	X		3	Survey of Psychoacoustics	Auditory stimulus, hearing mechanism, man's ability to discriminate sounds
			X	3	Psychophysics of Audition I	Psychophysical analysis of the auditory system
			X	3	Psychophysics of Audition II	Signal detection theory: human psychophysics; elements of decision theory
	Speech		X	3	Psychoacoustics	Instrumentation research techniques and significant literature pertinent to normal auditory attributes
	Speech and Hearing Sci.	X		3	Acoustic Phonetics	Acoustic parameters of speech; emphasis on electrographic analysis of speech
			X	3	Physiological Acoustics	Scientific study of normal and abnormal auditory systems
Wash. Univ., St. Louis	Architect.	X		0.5	Architectural Acoustics	Fundamentals of architectural acoustics
	Elec. Eng.	X		3	Electroacoustics	
	Speech and Hearing	X		3	Electroacoustics	
Wayne State Univ.	Psych.	X	X	5	Sensory Processes	Covers basic facts of auditory and visual systems
			X	4–12	Seminar in Audition	Topics range from physiological to psychophysical aspects of hearing
		X		2–8	Directed Study	Intensive reading of auditory literature
Western New England Coll.	Elec. Eng.	X		3	Electroacoustics	
Western Ontario, Univ. of	Phys.	X		3	Physics of Music	All aspects of music and musical instruments from the physical standpoint
W. Va. Univ.	Speech Path Audiology	X		3	Basic Speech and Hearing Science	Application of certain principles of physical sciences to understanding the processes of human oral communication
			X	3	Advanced Speech Science: I Acoustic Phonetics	Advanced detailed study of experimental research in acoustic phonetics; laboratory
			X	3	Advanced Speech Science: II Physiological Phonetics	Advanced experimental research in physiological phonetics
			X	3	Hearing Science	Experimental research in psychoacoustics
			X	3	Laboratory Instrumentation in Speech and Hearing Sciences	Instruments employed in speech and hearing sciences research, their design and application; experimental projects
			X	3	Noise and Hearing I	Investigation of the audiologist's role in the study of noise and its effect on hearing
Wisc. State Univ.	Communicative Disorders		X	3	Speech and Hearing Science	Psychological, acoustical, anatomical and physiological characteristics of normal speech and hearing laboratory
			X	4	Advanced Speech and Hearing Science	Experimentation and experimental literature relative to speech production, transmission, and perception
			X	4	Theories of Hearing	Psychoacoustic and bioacoustic aspects of hearing; nature of auditory stimuli and perceptual behavior; localization and other factors

Courses with Major Acoustics Content—Continued

INSTITUTION	DEPARTMENT	LEVEL Under-grad.	LEVEL Grad.	CREDIT HOURS	COURSE TITLE	DESCRIPTION WHERE PROVIDED AND PERTINENT
Wisc., Univ. of	Communication	X		3	Basic Procedures in Audiology	Administration and interpretation of hearing tests
		X	X	3	Advanced Procedures in Audiology	Calibration problems and techniques; interpretation of audiometric findings
	Communicative Disorders	X		3	Speech and Hearing Science I	
		X		3	Speech and Hearing Science II	
			X	3	Speech and Hearing Science I	
			X	3	Speech and Hearing Science II	
			X	3	Psychoacoustics	
			X	3	Acoustical Phonetics	
			X	2–3	Seminar: Speech Science	
	Geology and Geophys.	X	X	3	Introduction to Wave Propagation	Mathematics and physics of sound-wave propagation in one- two- and three-dimensional systems
		X	X	3	Marine Geophysics	Use of underwater sound in remote sensing of the sea floor
	Linguistics	X	X	3	Introduction to Experimental Phonetics I	
		X	X	3	Introduction to Experimental Phonetics II	
	Psych.		X	2	Seminar: The Psychology of Hearing and Communication	
Woods Hole Oceanographic Inst.	Geophys.		X	3[a]	Marine Geophysics	General course, includes acoustics
			X	3[a]	Underwater Sound Transmission	Theory
			X	3[a]	Seismology (marine)	Theory, practice, data work
			X	3[a]	Oceanographic Instrumentation	
			X	3[a]	Acoustics and Marine Animals	
Yale Univ.	Drama		X	3	Theatre Engineering	Introduction to physical acoustics and its application to performing arts facilities

[a] Semesters.

Education in Acoustics

Editorial Note: *The following two notes are addenda and corrections to the material on "Education in Acoustics" in J. Acoust. Soc. Amer.* **48**, *442–476 (1970).*

Availability of Formal Courses in Acoustics in Colleges and Universities

JOHN C. JOHNSON

Ordnance Research Laboratory, The Pennsylvania State University, University Park, Pennsylvania

Courses with Major Acoustics Content

INSTITUTION	DEPARTMENT	LEVEL Under-grad.	LEVEL Grad.	CREDIT HOURS	COURSE TITLE	DESCRIPTION
Teachers Coll., Columbia Univ.	Speech Path. and Audiology		X	2	Electronics and Acoustic Instrumentation	Basic concepts in electronics; principles involved in power supplies, amplifiers, audiogenerators, and laboratory instrumentation
			X	2 or 3	Bioacoustics	Critical study of the macro- and micro-anatomy and physiology of the auditory mechanism
			X	2 or 3	Psychoacoustics	Principles of psychophysics; scales of measurement and functions of perceptual auditory attributes; analysis of psychophysical methodologies underlying selected audiological tests
			X	2	Auditory Physiology	Study of the mechanics and electrophysiology of the middle and inner ear; theories of hearing; central auditory function; electrophysiological research procedures; for advanced students in audiology
			X	2 or 3	Identification Audiometry and Hearing Conservation Programs	Principles and practices of school identification and hearing conservation programs; problems of industrial and military audiology including ear protection, susceptibility, sound-level measurements, and damage-risk criteria
			X	2 or 3	Clinical Audiometry: Principles and Procedures	Pure-tone air- and bone-conduction audiometry; principles of masking; speech audiometry
			X	2 or 3	Differential Audiometry, I	Tests used in differential diagnosis of auditory disorders; automatic audiometry, loudness matching procedures, tests for functional hearing loss, difference limen tests, tests of abnormal auditory adaptation
			X	2 or 3	Differential Audiometry, II	Advanced tests for differential diagnosis including evoked response audiometry, galvanic skin-response audiometry, impedance measurements, and tests for central auditory problems
Yale Univ.	Eng. and Appl. Sci.	X	X	3	Probability and Stochastic Processes	Elements of set and measure theory; probability distributions, moments, characteristic functions, the central limit theorem; basic properties of random processes, stationarity and ergodicity correlation functions, and power spectra; linear and nonlinear operations on random processes
		X		3	Communication Theory	Representation of random processes; continuous communication systems (AM, FM, PM); the discrete process point of view of communication theory; optimum receiver principles; coherent detectors; channel capacity and the encoding problem elements of coding; parity-check codes; convolutional encoders; sequential decoding
			X		Mathematical Analysis of Random Signals	The physical causes of random disturbances, such as thermal and shot noise; representation of random processes and their properties, including statistics of zero-crossings as well as envelope and phase of narrow-band noise; spectral properties and other statistical properties of random processes after passage through nonlinear networks
			X		Information Theory	Shannon's mathematical theory of communication; source entropy, channel capacity and the fundamental coding theorem for discrete and continuous channels; information transmission under a specified fidelity criterion
			X		Detection and Estimation Theory	The application of probability and information theory to the design of optimum reception systems; a survey of recent theories in signal detectability, optimum reception of signals in noise, maximum-likelihood receivers
			X		Estimation Theory	Statistical background, Bayes, minimax, maximum-likelihood estimators, the Cramer–Rao bound, optimum estimators of phase, amplitude, time of arrival; analog modulation systems, Wiener and Kalman filters
			X		Stochastic Processes	

Appendix E

BOOKS ON NOISE, ACOUSTICS, AND RELATED PROBLEMS

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APPENDIX F

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Aviation Week and Space Technology

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Current Science

Ecology

Engineering News-Record

Environment

Environmental Control & Safety Management

Environmental Engineering

Environmental Research

Environmental Science and Technology

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